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Contents.

	PAGE
Notes and Comments	507
Pattern-makers' Wood Grinding Machines	508
The Kryn & Lahy Works, Letchworth	509
Book Reviews	511
Investigation of Brass Foundry Fluxes	511
The Influence of Special Elements when added to Commercial Cast Iron—Part I.	512
Heat Treating Cast Iron	514
Non-corrosive Steel	514
Pattern Plates for Floor and Machine	515
Institution of British Foundrymen	519
Wood *versus* Iron Patterns	520
Trade Talk	521
Iron and Steel Markets	522
Gazette	524
Personal	524
Deaths	524
Company News	524

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NOTES AND COMMENTS.

Runners.

The Brunelli process of filtering cast iron, on which we commented in our last issue, has received somewhat favourable notice in the current issue of "La Fonderie Moderne" in a long article by Mons. E. Ronceray, who has made a series of experiments, in which successful castings were produced by replacing the feeding cup by a runner of extremely small cross-section. Unfortunately, the experiments have not been carried out on a sufficiently large scale to dogmatise, and have only been published with the idea of arousing such interest in the subject that others may confirm or disprove the results. After crediting Brunelli with being the first person to use systematically a process incorporating the use of thin jets of iron, M. Ronceray agrees that in some cases feeding cups can be entirely dispensed with. In support of this statement it is pointed out that a series of threaded bushes for a moulding machine weighing 81 lbs., which had to be machined all over, and required to be quite sound, was cast by means of two $\frac{3}{8}$-in. gates. The method gave a close-grained iron, and naturally the runner discard was extremely low.

One experiment was tried with the object of casting the mould outlined with only one such stream; some difficulty, however, was experienced, but the author believes he can successfully accomplish it by a small-sectioned runner cut through the centre of the core. Taking the above into consideration, M. Ronceray states definitely that heads of metal for feeding purposes are no longer necessary, at least for the majority of such castings, and the most important factor is the section of the runner. After all, much is not understood in foundry practice; for instance, the questions of contractions varying with the shape of the casting and the density of hot iron are still awaiting solution. It is just possible that cast iron may be analogous to water in regard to a sudden expansion just before freezing. Cold cast iron, though denser than hot, floats on liquid cast iron, and it is difficult to ascribe it always to surface tension. A cylindrical shell will not always resist the casting of an internal ring, as, for instance, a pug-mill pan cast in one piece from phosphoric iron mixture burst the chill. Thus it becomes increasingly necessary to understand the laws governing the density of iron at high temperatures, as they are both complicated and contradictory.

According to the theory generally admitted, that cast iron contracts between casting temperature and solidification, but should this contraction be solely due to the escape of gases, then it may be possible to institute such casting conditions that the gases are evolved before the entry of the iron into the mould proper, and apparently it is on this basic principle that both the Brunelli process and the method advocated by M. Ronceray are centred.

Unquestionably, providing it can be accomplished without detriment to the casting, the abolishing of feeder heads would effect an enormous economy. Further, the iron immediately below the runner basin is invariably coarser than the remainder of the casting, and, moreover, often contains a hole or at least blowholes. For castings which have to withstand pressure the fault is often to be found in this position.

The experiments made by the author go to show that it is not always the castings which are the most difficult from the moulder's standpoint which give the greatest difficulty when casting without feeders and risers; in fact, they often prove to be the easiest. The firm with which the author is connected now make 80 per cent. of their machine-moulded castings, most of which have to withstand hydraulic pressure, without feeders or risers. Scrapped castings resulting from porosity are unknown, and the trouble, which is surmounted by an extra machining allowance, is an occasional depression due to variations of casting temperature in relation to the cross-sectional area of the small jets. Some idea of the saving to be gained will be realised from the fact that the weight of a cross-head for a moulding machine is 320 and the weight of the feeding arrangements 7½ lbs., or 2.3 per cent. Other examples figure out at 3 to 4 per cent., but these figures are for tall castings run from their base.

From the illustrations and diagrams, which we hope to publish shortly, there would certainly appear to be sufficient practical evidence to induce those foundrymen who have not experimented on these lines to make a few simple trials.

Pattern-makers' Wood Grinding Machines.

The practice of wood grinding in pattern-making has made such rapid strides during the past few years that it is now accepted as an indispensable manufacturing operation in large and small establishments. The tremendous amount of bench work and highly skilled hand labour saved by simple machine operations has created and fostered the development of ingenious and well-designed sand-papering machines to meet the ever-varying needs of the pattern-maker.

In the majority of pattern shops the wood-grinding machinery is used by all the pattern-makers as circumstances demand, the object being

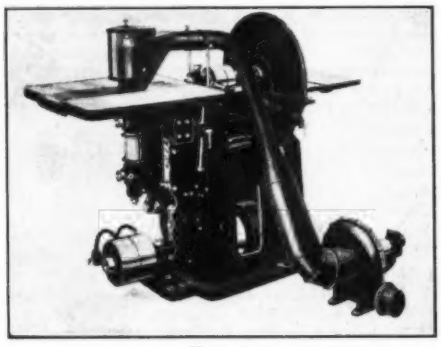


Fig. 1.
Combined Disc and Vertical Reciprocating Wood Grinder.

to reduce the laborious and lengthy hand operations which occur during the courses of manufacture and building up of patterns. The machines, therefore, supplement the actual bench work in addition to preparing and finishing components that come direct from the band saws and other machines. By this it will be seen that such machines may be classed as general utility tools, and do not require, in the absence of considerable repetition work, special woodworking machinists. The design carried out in the two wood-grinding machines illustrated in Figs. 1 and 2, and manufactured by Messrs. Wadkin & Company, of Leicester, adequately and economically meet the needs of all classes of pattern work; the machines are easily manipulated, and having guides and labour-saving devices can be quickly and accurately adjusted by the pattern-maker.

The combined disc and vertical reciprocating drum wood grinder is illustrated in Fig. 1. This machine will grind to a finish flat or external curved surfaces on the disc and internal and external curved surfaces on the reciprocating drum, and in both cases with either square or bevelled edges. The main frame is a single casting, with a large base. A steel shaft running in adjustable phosphor-bronze bearings carries the steel disc in such a manner that it can be removed, and on being replaced runs perfectly true. Fast and loose driving pulleys enable the disc to be started and stopped. The vertical drum at the opposite end of the machine is carried in a vertical sliding frame, arranged to reciprocate vertically from a suitably-geared crankshaft. The drums are of timber, split, covered in felt, and held on the spindle between cone cups, which method enables the drums to be changed by releasing one nut. A simple grip arrangement holds the abrasive paper perfectly tight. The spindle is steel, and runs in adjustable phosphor-bronze bearings, and an adjustable thrust bearing takes the weight of the spindle. The work tables are arranged to cant above and below the horizontal; the disc table carries a swivelling fence, which can be used either right or left-handed, the principal angles being clearly marked on the table. The drum table is provided with gap plates to accommodate various sizes of drums. The countershaft is in the base of the machine, and the belt drives, the disc and drum inside the body, making a perfectly simple and effective arrangement. Every care has been taken in designing this machine to ensure continuous service, the question of lubrication has been given careful consideration, and the methods employed ensure no grit entering the bearings and vertical slide. The machine shown is fitted with an effective and self-contained dust-collecting system, which keeps the machine and operator free from this annoyance. Two sizes of machines are manufactured, one with a 22 in. diameter disc, which requires a total floor space of 4 ft. 8 in. by 2 ft. 2 in., and the other with a 30-in. diameter disc, requiring a total floor space of 5 ft. 4 in. by 2 ft. 10 in.

The vertical reciprocating belt wood grinder is shown in Fig. 2, and is suitable for all kinds of flat and curved work with square and bevelled edges. For finishing flat and irregular surfaces, internal and external scroll work to fine limits, the design offers many advantages.

The main frame of the machine is a cored casting carried on suitable stands, in which are two long bosses through which the reciprocating belt frame columns slide vertically. The reciprocating frame is provided at one end with adjustable phosphor-bronze bearings, carrying the large cast-iron belt drum and shaft. The small belt drum is arranged to run in dustproof ball bearings, carried in a special swivelling bracket, which slides backwards and forwards by lever, for tensioning the belt; it is made of steel and covered with vulcanised rubber. The swivelling screw adjustment allows the belt being tracked to run perfectly true on the drum; this latter adjustment is practically only required when a new belt is put on.

The vertical reciprocating motion is obtained by a double-ended crankshaft, operating two adjustable lifting levers, which are applied to the vertical sliding columns of frame in conjunction with balancing springs, and in such a manner that the vertical lift of the frame at all times is positive and properly timed at both ends; all pin joints are adjustable for wear.

The machine is fitted with three work tables, one for the large drum, one for the small drum, and another at the side of the abrasive belt. The two latter tables cant above and below the horizontal, enabling bevelled work to be carried out, and are adjustable to or from the belt. The side

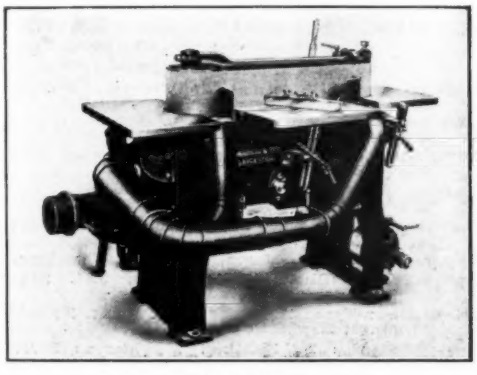


Fig. 2.
Vertical Reciprocating Belt Wood Grinder.

table is fitted with a universal swivelling fence, enabling plain and compound angular work to be easily produced.

The machine is supplied with the usual accessories, and is complete with a self-contained countershaft with loose and fast pulley and striking gear.

A copy of tender form and conditions of contract relating to a call for tenders by the Government Press, Bulaq, Cairo, has been received by the Department of Overseas Trade for the supply during 1921 of :—Antimony best refined, 5,100 kilos.; lead, pure, in pig, 18,800 kilos.; tin, in rods or ingots, 3,300 kilos. The material is required for making type and must be guaranteed as virgin metal by the tenderer. Tenders will be received by the Controller of Printing and Stationery, Old Ismailia Palace, Sharia Qasr el Aini, Cairo, up to noon on June 30, 1921, and it is stipulated that the tenderer must be a person residing in Egypt or must have a representative in Egypt. Each tender must be accompanied by a provisional deposit of 2 per cent. in money of the total value of the offer. Only Post Office orders or cheques on local banks will be accepted.

The Kryn & Lahy Works, Letchworth.

Situated in the reserved factory area of Letchworth Garden City in Hertfordshire, the steel foundry and engineering shops of Messrs. Kryn & Lahy Metal Works, Limited, now cover approximately 27 acres, of which some six acres are under roof. This factory was entirely erected and completely equipped during the war and found employment for about 3,000 Belgians, who, however, were repatriated shortly after the Armistice. The works, now under British management, normally find employment for 900 to 1,000 workpeople, of whom about 20 only are Belgians, who were specially retained in the steel foundry on account of their skill in this class of work.

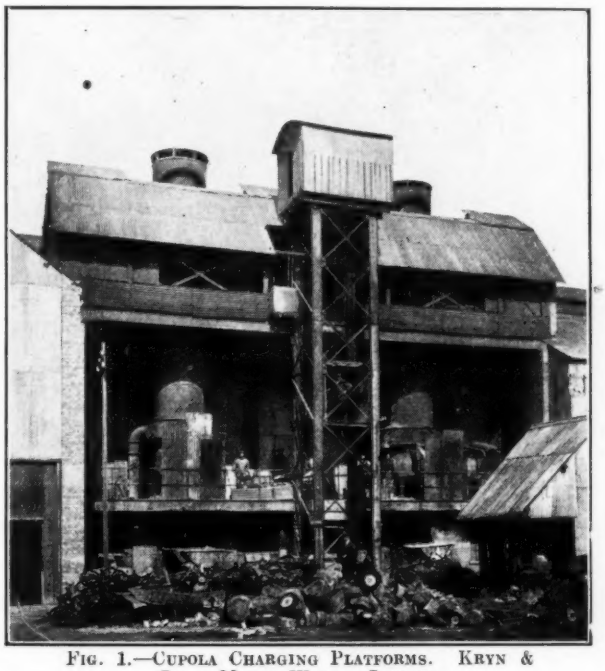


FIG. 1.—CUPOLA CHARGING PLATFORMS. KRYN & LAHY METAL WORKS, LIMITED.

The wartime production of the works was high-explosive and chemical shells for the Ministry of Munitions and the manufacture of tank parts and "Inglis" portable bridges for the War Office. Shortly before the Armistice arrangements had been made for the factory to turn over to the manufacture of Eagle aeroplane engine parts for Messrs. Rolls Royce, Limited.

The steel foundry is now engaged upon the production of all kinds of steel castings, ranging in weight from a few pounds up to two or three tons, and includes railway-wagon wheels, loco. wheels up to 7 ft. in dia., buffer plungers, buffer cases, horn blocks, motion plates, ships' anchors, davit arms and frames, slide-bar brackets, roof bars, C.S. pistons for large steam engines, headers for superheaters, motor lorry wheels, and back axle cases, valve bodies, etc. This foundry is a single building in two bays under one roof 730 ft. × 146 ft., and has a handling equipment of two 15-ton and five 5-ton overhead electric cranes. The melting plant consists of six Tropenas steel converters, each of a capacity of 25 cwt., together with the cupola equipment and one Electro-Metals electric furnace of 30 cwt. capacity.

FIG. 2.—VIEW OF TROPENAS CONVERTERS. KRYN & LAHY METAL WORKS, LIMITED.

There is an adequate range of annealing and core-drying furnaces, with a range of moulding machines of many types, including hand-operated, compressed-air, and hydraulic. Sand grinding

and mixing is carried out entirely by an automatic mechanical plant. There is a large shot-blasting department, and both electric and oxy-acetylene plants are installed for cutting off risers, welding, etc. A central power house contains the electrically-driven air compressors, which supply pneumatic power for the whole of the works; the main distribution boards are also installed in the power house. The whole of the works are electrically driven, power being taken from the generating station of the Letchworth Garden City Company, Limited. In point of fact these works take about one-half of the full normal load of the station.

The output capacity of the foundry is approximately 600 to 800 tons of steel castings per month on a day shift only, though as a matter of fact the output has actually reached a total of 2,000 tons of liquid steel per month on a day and night shift. The heat treatment of the castings has been made the subject of special care, and all the annealing furnaces are equipped with self-recording thermo-electric pyrometers.

A chemical and metallographical laboratory provided with up-to-date micro and photographic apparatus controls the chemical composition of the raw materials and liquid steel, and the structure of the castings after heat treatment. A careful check is kept on the steel at every step throughout its manufacture, a system having been devised and put into operation whereby the complete history of every casting despatched may be obtained when required.

FIG. 3.—MAIN BAY IN FOUNDRY. KRYN & LAHY METAL WORKS, LIMITED.

The majority of the castings produced in the foundry are of mild steel of good machining qualities. The following is a typical result of a test taken on a British Standard Specification test-piece:—Tensile strength, 30.8 tons; elongation, 34 per cent.; yield point, 17.4 tons; reduction in area, 44.6 per cent.; bend test, over 180 deg. without sign of flaw or fracture.

FIG. 4.—VIEW IN FOUNDRY. KRYN & LAHY METAL WORKS, LIMITED.

A speciality is also made of high-permeability magnetic steel castings for electrical work. Many of the castings produced are rough machined or finished in the machine shop before despatch.

The machine shop consists of one large shop covered by several bays of a total area of 385 ft. × 188 ft., and its equipment includes some 300 high-class modern machine tools. One large bay of the shop, served by a 5-ton overhead electric crane,

is devoted entirely to the machining of castings from the foundry and the manufacture and assembly of ships' davits for the Welin Davit and Engineering Company, Limited; these davits being finally tested under joint Board of Trade and Lloyd's inspection prior to despatch direct to the Clyde and East Coast shipyards. The shop contains a physical test department, tool room, grinding, hardening, and heat-treatment departments. The remaining buildings are occupied as assembly shops, general stores, garage, etc.

On a site close to the factory the company have erected a canteen with accommodation for 1,000 people and a hostel for housing about 80 men. Owing to the housing difficulty, which is very acute in Letchworth, the hostel and canteen have proved extremely useful, the former being usually fully occupied.

Notwithstanding the serious handicap that a steel foundry such as this would appear to suffer from in view of its geographical position, it is a fact that this has little or no effect upon the ability of the firm to compete with other foundries more favourably situated for deliveries in the North of England and even in Scotland.

Book Reviews.

"THE SOCIAL AND INDUSTRIAL HISTORY OF SCOTLAND." By James Mackinnon, M.A., Ph.D., D.D. Published by Messrs. Longmans, Green & Company, 39, Paternoster Row. Price 16s. net.—Perhaps the late war has created a desire for a fuller knowledge of recent history, and the book under review has been written for such a purpose. Dr. Mackinnon has been fortunate in the choice of his technical advisers, with the result that though only a brief and elementary description is given of Scottish metallurgical processes, they are at least correct. At the end of the book there appears a list of the sources from which information has been obtained, and this should form a useful bibliography for persons investigating this subject. The varied character of the book will be realised when it is pointed out that it deals with such diverse subjects as the progress of agriculture, mining, iron and steel, religious life, poor relief and crime, the rise of Scottish art, textiles and railways. The book fills the gap between the place where school-taught history is often broken off and that through which we have lived.

DIE FORMSTOFFE DER EISEN-UND STAHLGIESSEREI. By Carl Irresberger. — Berlin, W.9: Julius Springer. (Price 24 marks.)

In this treatise, extending to about 240 pages, with as many illustrations, the author has endeavoured to give a succinct and up-to-date account of the state of our present knowledge and practice regarding moulding materials used in iron and steel foundries, based on sundry papers in German and other technical periodicals, his own professional experience, sundry publications of the American Society for Testing Materials, and some treatises of American experts such as D. Dale Conduit ("Mineral Characteristics of the Moulding Sand"), H. C. Londenbeck ("The Microscope as a Test for Moulding Sand"), and H. E. Field ("Rational Analysis of the Moulding Sands"). Mr. Algerson Curtis has lent the author some microphotographs for reproduction. Among the periodicals we find our JOURNAL several times referred to.

The book is divided in two parts, in the first of which the various materials used by the moulder are dealt with in great detail, while their preparation for use in the foundry are described in the second part of the book. The materials are grouped under the following five headings:— (1) The moulder's materials as found in nature (sand, clay, marl, loam, etc.), their mineralogical constitution, their properties and methods of testing them; (2) auxiliary materials, like coal dust, etc.; (3) corebinders; (4) coating materials for patterns (charcoal dust, graphite, etc.), and substitutes; (5) substances for the preservation of patterns. In the second part are discussed the drying, crushing, mixing, cleaning of old moulding sands, etc. Drying ovens and numerous types of crushing, mixing and cleaning machines are described in detail and illustrated by photographs and line drawings, as well as machinery for handling moulding sands and preparing the clay, loam, etc., for the moulder. There is a good index. We can recommend the book confidently as a trustworthy guide to both the theoretical investigators and the practical worker.

Investigation of Brass Foundry Fluxes.

By C. W. HILL, Ph.D., T. P. THOMAS, W. B. VIETZ, Pittsburgh, Pa.

The term foundry or casting fluxes, as used here, refers to the substances added to molten metals, preparatory to casting into moulds or ingots, with the object of removing small amounts of impurities that have been introduced in handling or melting the metal, which was placed in a fair state of purity by the previous refining or metallurgical processes.

As commonly used, the term fluxes is applied to such materials as ammonium chloride, zinc chloride, salt, borax, and boric oxide. A second class of materials, usually called deoxidisers, includes substances such as metallic phosphides, sub-oxides, carbides, and bromides, that reduce the metallic oxides present in the metal. A third class includes various compounds that are molten and non-volatile at the temperature of the molten metal and are used primarily to protect the surface of the metal from the action of the furnace or exterior atmosphere; to this class belong such mixtures as lime and fluorspar, lime and soda ash, various minerals, etc.

The experiments on the nature and amounts of impurities made by the authors are limited to the solid impurities introduced into commercially pure aluminium by melting in an oxidising atmosphere in different kinds of crucibles, and to the solubility of hydrogen in molten copper and its alloys. The latter experiments form the subject of a separate paper, but are outlined here.

The amount of hydrogen that can be liberated from molten copper and its alloys upon solidifying and cooling to room temperatures has been determined. The physical action of fluxes is very rapid and appears to be greatly out of proportion to the amount of flux added.

We have no evidence that the chloride fluxes produce any change in the composition of the metal, the chloride coverings may remove metallic oxides to some extent, while the deoxidisers accomplish this result much more effectively. The physical effects of the chloride fluxes will then be largely those produced by surface changes, but these changes may be great and of considerable practical importance.

In the case of deoxidisers there is more or less complete removal of oxide impurities. If these oxides are merely suspended or physically mixed with the metal, the physical changes in the metal will not be great except where a surface change is produced at the same time. If, however, the deoxidiser removes an oxide from solution in the metal such physical properties of the metal as melting point, viscosity, and surface tension may be changed. These changes on the molten metal are likely to be small in comparison with surface changes. Their effects on the physical properties of the cast metal, on the other hand, may be great, as in the case of copper, in which they change nearly all of the mechanical properties and the electrical conductivity.

We are therefore forced to the conclusion that the real action of such fluxes is physical in nature. It may be largely mechanical. That is, the rapid evaporation of the flux at the points of contact with the surface film may mechanically break the film, allowing the molten particles to unite. The flux may penetrate through the film and react with the metal below, giving a volatile substance which disrupts the film. Since the fluxes themselves and the volatile products, possibly by a chemical reaction, are of about the same volatility, this explanation does not appear to hold.

* Abstract of a Paper read at the American Institution of Mining and Metallurgy.

The Influence of Special Elements when added to Commercial Cast-Iron.—Part 1.

By J. E. Hurst.

Much interest has been aroused from time to time on the subject of the influence of additional elements, other than those normally present, on the physical and mechanical properties of commercial cast iron, and almost every founder has at some time or other made experiments in this direction, with the object of improving the quality of his product. The extensive use of special alloy steels, on account of the special properties they have been found to possess, has also probably been responsible for redirecting the attention of foundrymen to this question in relation to cast iron. Considerable progress has been made in connection with steels in accumulating systematic data regarding the influence of special elements on the constitution and properties of the simple carbon steels. For this progress we are largely indebted to the earlier work of Guillet, Guillaume, and their collaborators in France, and the later work of Arnold and Read, Sir R. Hadfield, Swinden, Brearley, Edwards, and others in this country.

With hardly any exception, such systematic data in connection with the influence of special elements on the properties of cast iron is very meagre, and in many cases it is often very difficult to be perfectly sure of the validity of the information available.

The normal constituents present in commercial cast iron other than carbon are well known, and are silicon, manganese, sulphur, and phosphorus. In addition many brands of commercial cast or pig-iron contain traces, in varying amounts, of other elements, the chief of which are aluminium, copper, chromium, nickel, arsenic, and titanium. More minute traces of certain of the rarer elements are also met with and in almost every case the nature and amount of these elements present depends on the source of the ore from which the iron is obtained. The amounts of these elements present in typical brands of British pig-irons are very small and are very rarely considered in daily foundry practice.

Certain foreign irons are known containing fairly large quantities of certain elements such as nickel, chromium and titanium. The author has no knowledge of these irons possessing extraordinary properties to make their commercial value more widely known. Probably the most familiar of these special foreign irons is the so-called natural nickel-chromium pig-iron which is obtained from certain ores in Cuba. This pig-iron, known as Mayari pig-iron, has achieved a certain amount of notoriety in the U.S.A., and contains about 2.00 per cent. nickel and 1.0 per cent. chromium.

The addition of comparatively large quantities of special elements to cast iron with the object of producing special irons for special purposes does not appear to have been largely practised in this country. The writer has met with two types commercially manufactured on a large scale. These are, respectively, the now familiar high silicon alloys which possess non-corrodible properties and are largely used in the manufacture of chemical plant, and a special high nickel cast iron having a high degree of hardness which was used for certain machine tool parts and such articles as limit gauges. The intentional addition of small quantities of other elements to cast iron have been recorded, such as copper and aluminium to cast iron for motor cylinder castings and chromium for the manufacture of chilled rolls. Such additions along with the fairly frequent practice of adding certain ferro-alloys are generally made by individual foundries with the definite object of altering or improving the quality of their cast-iron for their own particular purpose.

Broadly speaking, experiments and investigations on the influence of special elements on cast iron have been confined to the determination of the influence of small quantities (quantities of 1 per cent. and less). In the majority of cases the addition of large quantities of special elements unless accompanied by some extraordinary valuable change in the properties of the resulting alloy is undesirable on economic grounds. Generally speaking, the high costs of the special elements coupled with the difficulty of melting, casting, and manipulating the resulting alloys, are of sufficient magnitude to outweigh the advantages in mechanical and physical properties obtained, and such additions are therefore only made in special cases.

The additional elements likely to be added to cast iron and on the influence of which a certain amount of published data is available are as follows: Copper, zinc, boron, aluminium, zirconium, cerium, titanium, tin, lead, vanadium, arsenic, antimony, chromium, molybdenum, tungsten, cobalt, nickel. Of these it is often alleged that addition of boron, zirconium, cerium, titanium, vanadium, and molybdenum are of especial value to the foundryman in promoting the ease of production of sound castings. It is proposed to consider these latter in a separate section.

Copper.—This element is normally present in many varieties of British pig-irons. It usually occurs in minute quantities rarely exceeding a maximum figure of 0.15 per cent. It is largely from this source that the copper found in castings originates and is likewise present in many steels. Dr. Stead* concludes that in steels there is overwhelming evidence that copper in quantities up to 0.5 per cent. have little or no influence on the mechanical properties, and the deleterious influence formerly credited to this element is a result of mistaken observations on the part of certain investigators.

The author has met with certain cast-iron castings containing quantities of copper up to 0.76 per cent. There is no doubt that the copper in such cases had been intentionally added. Copper in the form of rod, wire, or nails is frequently used in moulding operations and in the neighbourhood of chaplets and the like copper is likely to be found in castings.

Experiments have been published by W. Lipin† on the influence of copper when added to Swedish charcoal iron. It was found that 4.9 per cent. resulted in an increase in tensile strength of from 19 to 22 tons per sq. in.; and the relative fluidity of the metal was also increased. It was also concluded that the addition of copper did not tend to retain the carbon in the combined condition.

The presence of copper in quantities of over 1 per cent. is said to materially increase the resistance of cast iron to atmospheric corrosion, and it has been used in certain pipe work with the object of resisting the corrosion of slightly acid waters.

The iron-copper system has been investigated by Sahmen‡. Two series of solid solutions were shown to be formed, and the limit of solubility of copper in iron was found to be 3 per cent. No data is available on the behaviour of copper in the iron-carbon system, and in comparatively small quantities it probably exists wholly in solid solution.

Zinc.—There is no record of the presence of this element in cast iron, and the rapid oxidation together with the low volatility of this element probably precludes the possibility of its presence in molten cast iron.

Aluminium.—It has been shown by Melland and Waldron§ that the influence of aluminium when added to cast iron was very similar to that of silicon. It was shown that like silicon, additions of aluminium effect a reduction in the total carbon content and also assist in the precipitation of the graphite. The results of these investigations were variable, and additions of aluminium in excess of 0.50 per cent. were found to apparently increase

* J.I.S.I. 1916. No. 2.
† Stahl und Eisen. 1900. Vol. XX.
‡ Zeitschrift fur Anorg. Chemei. 1908.
§ J.I.S.I. 1900. Vol. 2.

the stability of the carbide and prevent the graphite precipitation, aluminium probably enters into solid solution in the alloys as the compound $Fe\,Al_3$*. In alloys containing considerable quantities of carbon it is possible that a double carbide of iron and aluminium may be formed, a fact which was suggested by Melland and Waldron as the possible explanation of the influence of excess aluminium in retarding the graphite formation.

Rhead states that the graphite deposited as the result of aluminium additions is generally in a finer state of division.

Tin.—The presence of tin in steel resulting from the use of tinned scrap in the smelting process has been shown by various investigators. In the case of steel it is found that the presence of this element tends to make the steel hard and stiff when in the heated state and consequently difficult to roll.

Guillet has investigated the influence of the addition of tin to cast-iron, and has shown that this element considerably increases the hardness due to the formation of a compound of tin and iron. In more recent experiments† conducted with the object of studying the hardness of cast iron used for press tools, particularly for shell piercing, Guillet concluded that the addition of tin in quantities of up to 5 per cent. would be a desirable addition to castings which are required to maintain a considerable degree of hardness at comparatively high temperatures. The results of these investigations are conveniently summarised in Table 1:—

TABLE I.—*Showing the Influence of Tin on Cast Iron.*

Sample	CC.	Gr.	Si.	Mn.	S.	P.	TotC.	Sn.	Normal Hardness	Temperature at which Hardness commences to fall off.	Hardness at 800°C.	Hardness after Heat Treatment	Remarks.
1	0.48	2.80	1.6	1.2	0.05	0.13	3.28	Nil.	196–228	600°C	48	207–228	Ordinary Sand-cast
2	—	—	0.42	0.99	0.123	0.112	2.96	Nil.	387–477	500°C	95	430–512	Chill Cast Steel
3	0.60	2.70	1.46	1.10	0.04	0.15	3.3	0.28	207–288	500°C	68	223–255	Mixture 25% Steel.
4	0.90	2.60	1.55	1.37	0.06	0.14	3.5	1.07	228–302	500°C	72	262–321	—
5	0.90	2.40	1.36	1.27	0.05	0.10	3.3	1.94	418–555	500°C.	68	418–455	—
6	0.70	2.20	1.27	1.21	0.04	0.14	2.9	4.64	444–600	500°C	126	495–600	—
7	—	—	0.28	0.94	0.11	0.14	2.6	0.54	321–364	500-600°C	163	364–444	Steel
8	—	—	0.37	1.05	0.10	0.08	2.4	0.88	302–364	500°C	116	364–444	Mixture containing tin.

Lead.—The iron-lead system has been partly investigated by Isaak and Tamman‡, who found that the two metals were only partially miscible in the liquid state. In blast furnace practice large quantities of lead have frequently been collected as a result of the reduction of lead compounds present in the ore. In these instances it has been observed that the molten lead is immiscible with the liquid iron.

Arsenic.—This element is frequently present in small quantities in certain pig-irons. Its influence on the properties of cast iron has not been investigated. In all probability its influence is analogous with that of phosphorus, with which constituent it is always associated.

Antimony.—The influence of this element is stated by Goerens to be similar to that of tin.

Chromium.—The extensive use of this element in the production of special alloy steels is probably responsible for the interest shown in this element in connection with cast iron, and a considerable amount of investigation has been carried on into the constitution of the iron-carbon-chromium series and the influence of chromium on the properties of steels.

An excellent summary of the work of previous investigators is to be found in a Paper by Dr. Edwards§, and a tentative ternary diagram of the constitution of the iron-carbon-chromium alloys in the annealed condition is put forward. It has long been known that chromium readily formed carbides and that these existed in the iron-carbon-chromium alloys. The compositions of the carbides proposed by various investigators as a result of their work is somewhat complex. Dr. Edwards and his collaborators show that there are good grounds at least for the existence of two carbides, viz., a double carbide of iron and chromium having the composition Fe_3C, Cr_3C_2 in steels having a carbon to chromium ratio of

FIG. 1.—TEST BAR (B), 3.89 PER CENT CHROMIUM ETCHED MAGNIFICATION, 100 DIAS.

1 : 4.3 and a second carbide of the probable formula Cr_5C_2 in steels above this carbon to chromium ratio. Excess chromium over and above that required to satisfy this formula probably enters into solid solution. No data is yet available respecting the liquidus surface of the ternary diagram and the extent of the influence of chromium on the graphitisation in the high carbon alloys.

On other grounds, however, it is legitimate to conclude that chromium exerts a powerful influence in preventing the production of graphite. In a cast iron containing 1 per cent silicon an addition of 0.90 per cent. chromium rendered the fracture quite mottled, and 4.0 per cent. chromium added to an iron containing 1.5 per cent. silicon rendered the fracture perfectly white, and drastic annealing at a temperature of 900 to 950 deg. C. failed to produce any graphite.

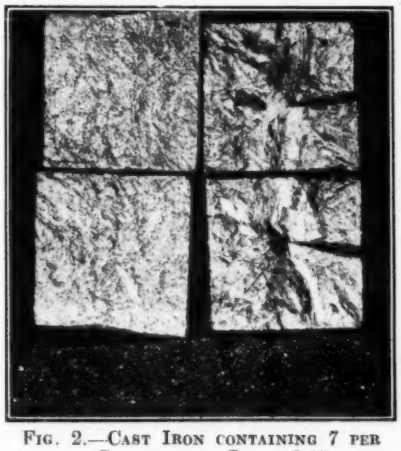


FIG. 2.—CAST IRON CONTAINING 7 PER CENT. CHROMIUM. LEFT—3.15 PER CENT. SI. RIGHT—1.46 PER CENT. SI.

* Gwyer, Z.A.C. 1903, 57, 129.
† Revue de Metallurgie, Researches on Shell Manufacture. 1917.
‡ Various Papers. See J.I.S.I. 1920. No. 1.
§ Z.A.C. 55, 59. 1907.

The analyses of the two bars are given in Table II. :—

TABLE II.—*The Analyses of the Two Chrome Cast Iron Samples experimented with.*

		Si.	Mn.	S.	P.	Cr.	Fracture.	Brinell.
Sand cast .. Test bars 12 in. by 1 in. by 1 in.	*a*	1.07	0.75	0.05	0.03	0.89	Mottled	387
	b	1.54	0.72	0.055	0.03	3.89	White	—

A microphotograph of bar "b" is illustrated in Fig. 1. The iron carbide eutectic is shown, and the long central needles are in all probability the double carbide of iron and chromium.

Further experiments made show that an increase in silicon content tends rapidly to reduce the stability of the carbide, and with 3.5 per cent. silicon and containing as much as 7.5 to 8.5 per cent. of chromium, test-bars were found to be graphitic and could be filed and drilled with some difficulty. A cast iron containing 3.15 per cent. silicon and 6.94 per cent. chromium gave a Brinell figure of 460 on a sand-cast bar and a chill-cast bar could be filed with difficulty. The same alloy containing 1.46 per cent. silicon was glass hard, white and showed no sign of graphite. The fractures of the two bars are illustrated in Fig. 2.

Campion gives the following results of experiments on the addition of chromium to cast iron, the silicon content of which is not stated :—

	Tot. C.	Gr.	CC.	Load.	Mod. of rupture.	Brinell.
Without chromium	3.371	2.54	0.83	509	44.310	228
1% chromium	3.431	2.34	1.09	573	50.640	230

The results of the experiments of Goerens on the influence of chromium upon the eutectic percentages of carbon show that with increasing quantities of chromium the carbon percentage corresponding to the eutectic increases and very little change takes place in the melting point until a percentage of 10.4 chromium is reached, after which the melting point gradually begins to increase.

Summing up, therefore, it appears to be quite definitely established that the influence of chromium on cast iron is largely one of preventing the formation of graphite. In small quantities it exists as a double carbide of iron and chromium which crystallises out with the eutectic.

There is no published data on the influence of chromium in promoting the resistance of cast iron to wear and to high temperature conditions.

Molybdenum.—The influence of this element upon the constitution and properties of cast iron does not appear to have been deeply investigated.

Tungsten.—As in the case of molybdenum, there is practically no published data on the influence of tungsten additions to cast iron. Campion states that additions of less than 1 per cent. of this element exert a comparatively small influence on the properties, but additions of from 1 to 2 per cent. lead to a considerable increase in strength, and the carbide is rendered more stable and suitable for high temperature work. It is not stated in what form the tungsten is added, and owing to its extremely high melting point some difficulty must be experienced in the assimilation of tungsten by ordinary cupola melted metal.

Nickel.—Guillet, Thaler, Hatfield and Campion all agree that the addition of nickel to cast iron produces dissociation of the carbide, with the consequent production of graphite. Even in low carbon alloys—steels—McWilliam and Barnes* have shown that 3 per cent. of nickel renders the pearlite carbide unstable and graphite is precipitated on drastic annealing.

Thaler states that as a result of his experiments the addition of 1 per cent. of nickel causes the separation of 50 per cent. of the graphite, and with further additions up to 47.78 per cent., over 85 per cent. of the total carbon was precipitated as graphite.

Professors Bauer and Piwowarsky in Germany have recently investigated the influence of small additions of both nickel and cobalt to cast iron. Their results are summarised in Table III. :—

TABLE III.—*The Influence of Nickel and Cobalt on Cast Iron.*

No.	Ni.	Co.	Tot. C.	Gr.	Cc.	Si.	Mn.	S.P.	Bending Strength. Kg. per sq. mm.	Tensile Strength. Kg. per sq. mm.	Brinell Hardness.
1	0.0	0.0	3.90	2.83	1.07	0.69	0.18	0.048	24.3	10.1	145
2	0.87	—	3.89	2.85	1.04	,,	,,	,,	31.3	12.5	171
3	1.25	—	3.76	2.91	0.65	,,	,,	,,	—	—	175
4	1.95	—	3.70	3.12	0.58	,,	,,	,,	28.3	11.10	149
5	—	0.91	3.89	2.88	1.01	,,	,,	,,	24.2	9.0	148
6	—	1.90	3.85	2.56	1.29	,,	,,	,,	19.3	9.3	152

The influence of nickel in increasing the proportion of free carbon is illustrated by these results, and it was also found that the addition of 1.20 per cent. nickel raised the fusion point of the iron by only 5 deg. C. It is very difficult to co-ordinate the hardness values with the results of the chemical analyses, and one would have expected irons containing over 1.00 per cent. CC. to have shown a much higher Brinell figure. The results of the other tests are summarised in the table.

Cobalt.—The effect of cobalt additions to cast iron was also investigated by the above authors. Their results are also included in the above table. It would have been expected that the behaviour of this element would have been analogous to that of nickel. From the results given above it will be noted that the addition of cobalt appears to prevent the formation of free carbon.

(To be continued.)

* J.I.S.I. 1906. No. 1.

Heat Treating Cast Iron.

There are two reasons for heat-treating cast-iron. The first is for the purpose of breaking down the internal stresses that exist in the casting. To accomplish this the casting is heated up to 550 deg. C., and kept at that temperature for several hours. The exact time necessary depends on the thickness of the casting. The operation is often practised on pieces to be partly machined, such as gas-engine cylinders, etc. The castings are placed in either a cast-iron or steel box, and lightly dusted over with powdered coke or charcoal. The box is then firmly closed and carefully luted up with fireclay.

The purpose of the second method is for softening the metal, especially castings of thin section which are liable to be chilled.

For arriving at this result it is necessary to carry the heating of the piece up to 850 deg. C. for one or two hours.—"Fonderie Moderne."

Non-corrosive Steel.

According to an American report, the firm of A. G. Fried Krupp has succeeded in producing a steel alloy which is claimed to be non-corrosive. It contains over 70 per cent. of iron, its other components being chromium and, in a lesser degree, nickel. The alloy is made in three different varieties. The first resembles silver in chemical qualities, but has inferior mechanical qualities. It is recommended for medical instruments, turbine blades, valves and the like. It is said to be immune against water and nitric acid, but not against sulphuric and muriatic acid. A second variety offers non-corrosiveness in a lesser degree, but is more ductile and malleable. As regards immunity against the chemical action of water, it is claimed to be superior to all existing steel alloys. A third brand, still more compromising between non-corrosiveness and mechanical qualities, is made for being used in cutlery manufacture and the like.

Pattern Plates for Floor and Machine.*

By C. Heggie.

As it is impossible in the course of an evening to deal with every phase of the subject it is only proposed to outline a few of the various kinds of pattern plates.

Turnover "All Cast" Plates.—The most common type of plate is the ordinary "turnover," with the plate and patterns as one casting. The term "all cast" will be used when referring to such plates. These, of course, can be used on the floor, bench or press, and on various types of moulding machines. As this class of plate has been used for years the description of the making of such

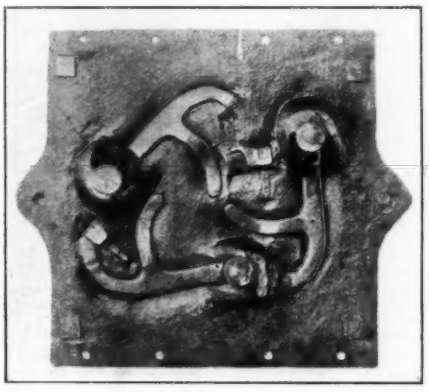


FIG. 1.

plates is not dealt with, though there are very few moulders, except those specially trained for the work, who can make a really good pattern plate. All the necessary essentials for the production of good castings are, perhaps to a greater degree, necessary for the making of a good "all cast" plate. The mould is made exactly as if castings were required. When the top mould is parted off a wood frame, the outside of which is the same size and thickness as the plate required, is placed on the drag, and sand is built up level with frame to the outside of the mould. When the

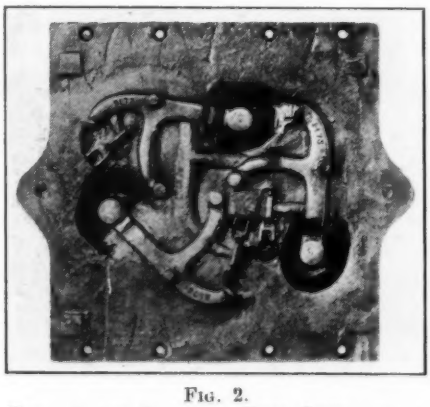


FIG. 2.

FIGS. 1 AND 2 SHOW BOTH SIDES OF A TYPICAL "ALL-CAST" PLATE FOR USE WITH MOULDING MACHINES.

top part is closed on it is, by the thickness of the frame, higher than its original position, so when the mould is cast a plate equal in thickness and size to the wood frame is produced, with part of the patterns on both sides.

Instead of the wood frame it is the practice in some foundries to use a machined cast-iron one. This is left between the top and drag when the mould is being cast, the inside of frame forming the outside of plate. Another variation of this method is to use a machined cast-iron frame, which becomes the outside part of the actual pattern-plate.

The inside of frame is made just large enough to clear the pattern and sand joints, and is placed on the drag before closing. The inside edges of frame are fitted with projections, or otherwise prepared, so that the metal when cast may be held securely to the frame.

Special moulding-boxes are usually reserved for this class of work. These should be strong and well fitted, the joints preferably planed. The number and position of patterns in conjunction with the position of runners should have the most careful consideration, and one should guard against

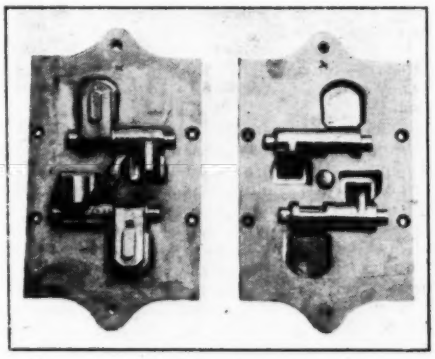


FIG. 3.—SHOWING SEPARATE PLATE FOR DRAG AND TOP, WITH PATTERNS SCREWED ON, SHOWING "BANKS" AND WHITE METAL RECESSES.

the natural inclination to get as many patterns as possible on plate. Many indifferent plates have been made through overcrowding.

The joints should be carefully made, the moulder satisfying himself by repeatedly withdrawing the pattern, if necessary, that he has really got down to the actual joint line. It is often advisable to give small templates to assist him in this. These templates, which are really depth gauges, fitting over the patterns at certain parts and giving the depth to joint line, often save much time and assure a perfect joint.

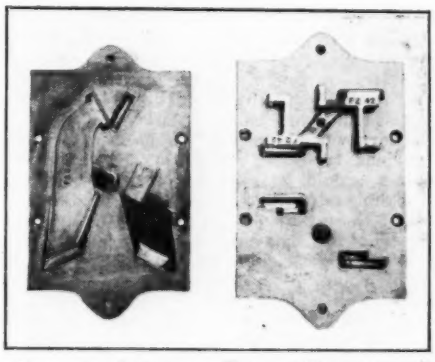


FIG. 4.—SHOWING TWO "REVERSIBLE" PLATES.

Where the formation of pattern causes pockets more or less deep the sides of such pockets forming the sand joint should be made back from the edge of the pattern, and given as much taper as space will allow. This, in addition to ensuring a better lift, is also better for closing, and makes a stronger plate owing to the extra thickness of metal gained by the increased taper. This may seem like stating the obvious, but if a number of plates are examined it will be found that many such joints could have been greatly improved by a little consideration.

The patterns should be lightly rapped, and, where possible, rapped through the top part of moulding box, to ensure any increase at the joint being on both sides. Continual thought and care is necessary to obtain a straight plate, as many

* A Paper read before the London Branch of the Institute of British Foundrymen.

of them are naturally very irregular in thickness owing to the patterns being cast-on. The irregular cooling caused by this variation in thickness tends to warp and bend the plate, if not counter-balanced in some way, the usual method being to bare (that is, to scrape the sand away) the heavier parts first, and so regulate the cooling. The time allowed between the casting of the plate and the "baring" is an important factor, and varies, of course, with the size of plate and class of pattern. When making these plates every day one gets fairly familiar with the necessary time to allow, and whilst no actual figures can be given it should be mentioned so that the value of recording the time of "baring" and making deductions from such records may be realised.

Even when plates are not "bared," it is often advisable to tip the moulding-box on its side and so allow a more equal cooling of the top and drag side of the plate.

It is advisable on plates of this class to cast fitting-strips on both sides at the four corners so that they can be more readily adjusted if slightly warped.

In some foundries instead of attempting to make the plate cool regularly, as described, the mould is cambered—that is, made hollow or round—so that the irregular cooling brings the plate straight. In the author's opinion this is bad practice, because when a straight plate is obtained, the result has been arrived at by the irregular cooling, and such a plate must, of necessity, have internal strains, and, therefore, be much weaker than a plate that has cooled in a regular way. There is really no limit to the size of these plates, so far as the making is concerned, and in an ordinary light castings foundry they are

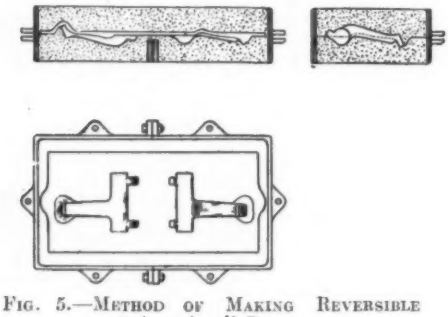


FIG. 5.—METHOD OF MAKING REVERSIBLE "ALL-CAST" PLATE.

used from 7 ft. long down to the ordinary 12 in. by 12 in. snap-flask plate. The ordinary run of floor plates are roughly 40 in. × 36 in., 36 in. × 24 in., 30 in. × 20 in., and 24 in. × 24 in., the thickness for such being about ¾ in. Many of these turnover plates can be used with success on various types of moulding machines, and machines should be used every time where there is a possible advantage to be gained, but there are many of these plates being worked to-day on the floor, that for many jobs, can compete successfully with any machine on the market. A wise seller of moulding machines will realise their possibilities, and will admit when occasion arises that his machines are of no use for certain jobs. The use of moulding machines in many foundries has been limited and retarded for years, from the fact that they have not started with machines suitable for their work. Figs. 1 and 2 show a typical "all-cast" plate for moulding machines.

The actual moulding of these plates is not an expensive matter, and the majority of ordinary floor-plates can be made by one man in a day or less, the time naturally varying with the size of plate, number of patterns, class of joint, etc. The moulding is the least expensive item in many cases.

There is the wood, plaster, or white-metal master pattern to be made, and the necessary number of castings from this. These have to be filed-up, and, so far as the joint-lines are concerned, filed accurately, and then again the patterns on the actual plate have to be filed, and this must be thoroughly well done.

Loose Patterns Cast-on.—In some cases it is possible to reduce the expense by casting the already filed patterns to the plate, and thus save the time taken in filing them when cast-on. The method of procedure is exactly as before described, but the patterns, which are prepared with suitable studs, projecting into the moulds, are left in the sand instead of being withdrawn, and the metal forming the plate cast around them. There are limitations to this method, and it will be readily seen that the patterns must of necessity be in two parts for a double-sided plate.

A variation of this is to withdraw the patterns, as in the first case, and then fill up the spaces left with sand, care being taken not to interfere with the joint line.

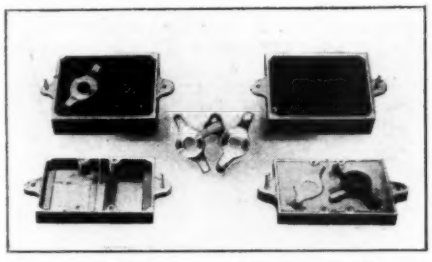
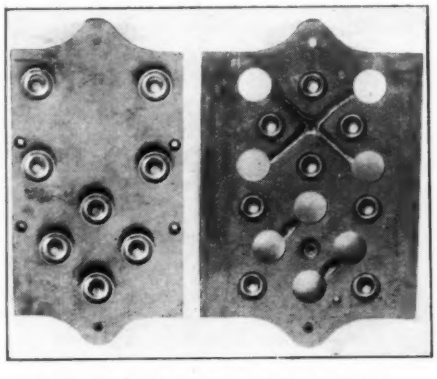


FIG. 6.—SHOWING A METHOD OF MAKING CHEAP PLASTER PLATES.

The filed patterns can then be screwed on to their respective positions on the cast plate. When possible, whether it is a turnover plate, or any of the other types mentioned later, it gives, with few exceptions, by far the best job to have the plates, preferably planed plates, and even in "all-cast" plates it is often better to have the runners made loose, properly adjusted, and screwed on.

When moulding machines are used, and even in some cases for floor work, it is always better to cut out the turnover plate when possible.

Two-plate Method.—To accomplish this, instead of patterns being on each side of the plate, they are fixed to two plates, that is, a separate plate for drag and top. More accurate moulding boxes are, however, necessary, and these must be interchangeable. In some foundries three pins are used in such boxes. The author considers the third pin quite unnecessary, and that two pins are in every way preferable. The holes in plates for box pins are usually drilled to a jig, the half-patterns are



Pattern Plate. Stripping Plate.

FIG. 7.

Note that when stripping plate is placed on pattern plate there are four patterns and the reverse side of four patterns on each side of centre line, thus giving 16 castings per box.

filed-up, jointed, dowelled, and finished-off. These are then separated and the halves arranged on one plate, the plate then being drilled from the dowel-holes in the pattern. The two plates are then fastened together face-to-face, by pins in the box pin-holes, and the second plate drilled from the first, thus ensuring the correct registration of the patterns on the second plate in relation to those on the first. The patterns are then fixed by the dowel-pins and additional screws. Such plates have the advantage of being able to be worked by two men for additional output, and when the boxes are of a suitable size, the tops and drags can be rammed on a hand or power press at one

operation. They can also be used for multiple-moulding, where one plate is fixed to the head of machine and the other to the bed, the impression from patterns on both plates being in the same part of moulding box.

It is better to eliminate the turnover-plate when possible. When a moulding machine is being worked, and it is found that a turnover plate is necessary, it is often so for one part of the mould only; in such cases it is advisable to make the two plates, as one-half of the mould can then be made on the straight-drawn machine. Such plates are not confined to patterns with level joints, many irregularly jointed patterns can be similarly treated and give a thoroughly satisfactory job, although entailing more expense.

The joints of patterns which stand above the plate are built up by "banks" and recesses made in the other to correspond with these "banks." To ensure these recesses being accurate the patterns are removed from the first plate, leaving the banks in position. Holes or recesses are cast, cored, or drilled in the second plate, large enough to clear the banks and allow of the plates being placed face-to-face. White metal is then poured into the recesses on to the banks. This white metal is held in position by the irregular edges in the recesses, or by "housings" screwed or cast on

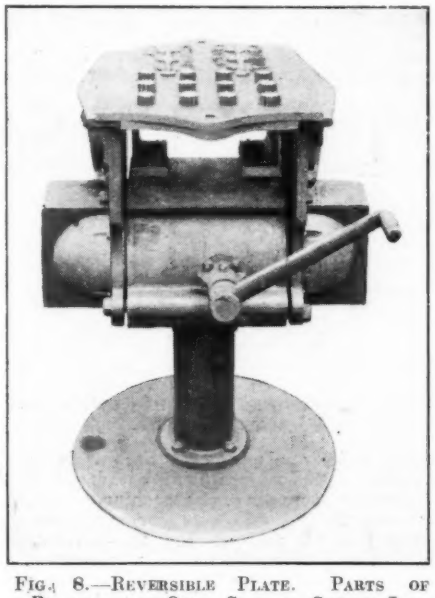


FIG. 8.—REVERSIBLE PLATE. PARTS OF PATTERNS ON ONE SIDE OF CENTRE LINE STRIPPED ON OUTSIDE, THE OTHER PARTS STRIPPED OUTSIDE AND INSIDE

back of plate. The plates are then separated and the half-patterns fixed as before to their respective plates.

Two Plates "All Cast."—It is just possible that cases may arise where two plates are required, but to build them up as described is impracticable, and so two "all cast" plates become necessary. The same method is followed as in making turnover plates, but instead of closing the top-part on the drag in the usual way, these are placed side by side, both being built up with a frame as before, to give thickness of plate, and plain tops are closed on both. Where the joint line stands a certain distance above the joint of box, it becomes necessary to scoop the sand out of the top part at such places to give the necessary plate thickness, or to build up the top to reduce the thickness at other places.

Reversible Plates.—With this class of plate the drag and top part are both rammed from it, the top being reversed when closing. The respective half-patterns are located equidistant from the centre line, and the method of making, whether the joints are level or irregular, is much the same as decribed in the two-plate method. The registration of the patterns and recesses cannot, of course, be done in quite the same way, and a special jig plate becomes necessary. The fact that there is only one plate and also only half the number of patterns are required for the same number of castings per box, compared with the two-plate method, makes the equipment cheaper, and at times even more castings per box can be obtained from a reversible plate than from the two plates. This is due to the fact that half the number of castings are in the drag, the other half in the top, and so may be cast, if arranged alternately, very much closer to each other. This same fact at times rules out the reversible plate, as for some jobs the deepest part of the casting must essentially be in the drag side of the moulding box.

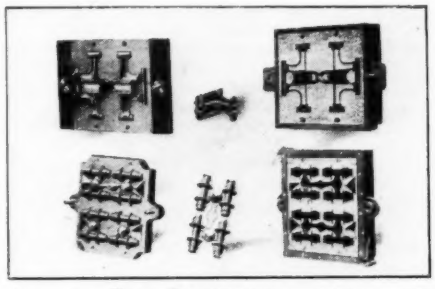


FIG. 9.—TOP ILLUSTRATION SHOWS THE PATTERNS MOUNTED ON A BOARD GIVING FOUR CASTINGS PER BOX. BOTTOM ILLUSTRATION SHOWS ANOTHER METHOD OF REVERSIBLE SYSTEM GIVING EIGHT CASTINGS PER SNAP FLASK.

When necessary a reversible "all cast" plate can be made, but special boxes are required. The usual method is followed, but when the mould is completed the top part is bolted to the drag through the snug shown, thus forming one complete drag. This is built up, as already described, to give thickness of plate, and a top-part, which is, of course, the size of the combined original top and drag, is then closed, preparation being made as before for the higher and lower parts of the joint.

Cheap Plaster Plates.—Much the same method can be adopted for making cheap plaster reversible plates, and the ordinary box part, divided by a centre bar, can be used instead of the special boxes in halves.

The mould is made in one division of the moulding box, as shown in Fig. 6, and when parted off the box part or frame to be used for plaster is placed on the first mould and the plaster poured on. When this is set the box is removed and placed over the second box, the open space being over the mould. Plaster is now poured over this, thus giving a complete reversible plate contained in the moulding box or frame. Projections, corners, and other weak parts on these plates that might be easily broken, are often strengthened by white metal. This can be nailed on or placed in the mould before the plaster is poured on.

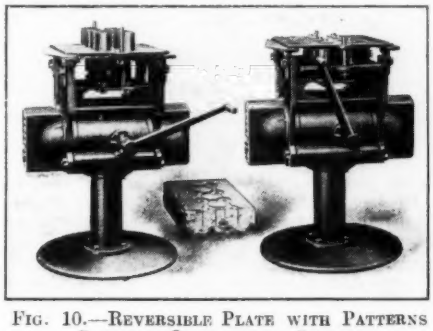


FIG. 10.—REVERSIBLE PLATE WITH PATTERNS STRIPPED OUTSIDE AND INSIDE.

One of the many advantages of plates over loose patterns is that all the patterns are withdrawn with one movement instead of being picked out separately. This often means an alteration to existing pattern before it can be "plated," or, at least, a different joint line from that used in a loose pattern. The latter can be withdrawn from the mould at an angle, or by a twisting movement, but an ordinary plate must be drawn square from the mould. It is here that some types of moulding machines are valuable. These machines

XUM

are arranged so that a perfectly square draw is obtained, either by dropping the pattern from the moulds, or by raising the moulds from the pattern. By the use of such machines taper on the patterns can be reduced to a minimum, and also a greater depth can be worked than in plates drawn by hand. No skill is required, the mould is left much cleaner, the castings are truer to size from the fact that less rapping is necessary, and a good deal of time is saved.

Stripping Plates.—With such machines the use of stripping plates for certain classes of work is a decided advantage. The pattern plate is fixed to

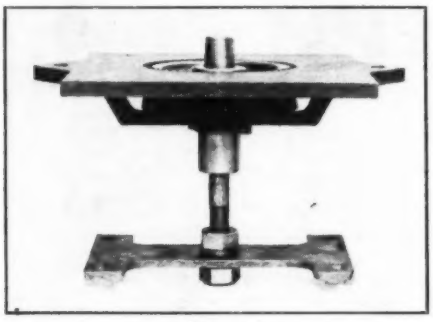


FIG. 11.

FIGS. 11 AND 12 SHOW THE METHOD OF DRAWING A FRAZER WHEEL PATTERN. THE BASE PLATE IS FIXED TO THE MOVABLE PART OF THE MACHINE, AND THE PATTERN IS MOVED BY A SLOTTED BUSH.

the movable part of machine, and when in position for use is level with fixed part. On this rests the stripping plate, which is fitted exactly to the outline of pattern, this having an additional depth equal to the thickness of stripping plate, the face of which forms the joint line. It will be recognised that when the mould is rammed up and the pattern withdrawn through the stripping plate, that scarcely a grain of sand can be displaced.

The inside of the pattern and other holes that would otherwise have to be cored can be moulded in green sand, and stripped in much the same

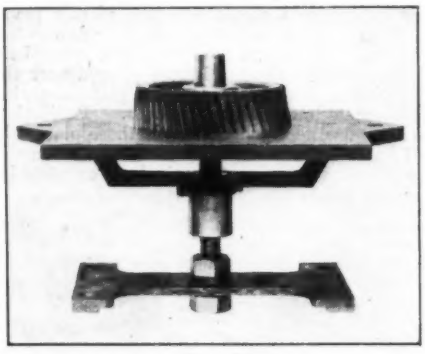


FIG. 12.

way as outside of pattern. This is done by internal stripping stools, and as these are essentially detached from the external stripping plate they are supported on a stool bracket, which in turn rests on main body of machine.

Lawn Mower Wheel.—Fig. 8 shows a good example of a reversible plate, and shows one side of the pattern stripped externally and the other part externally and internally.

Pulleys.—Fig. 10 shows the inside and outside of patterns stripped, and is, too, a reversible plate.

Varying widths of pulleys can be made as the position of pattern plates can be adjusted so that more or less of the pattern is made to project through the stripping plate. Of course, the actual casting is double the width of the pattern above the plate. It may often happen that the main body of a pattern does not, owing to its formation, require to be stripped, but projecting snugs, flanges, or gills do. In such cases the usual stripping plate is dispensed with, and such projections are drawn through the pattern body acting as the stripper. An air-cooled cylinder when the gills are drawn the body is a typical example of this.

Frazer Wheel.—This is a pattern most difficult to draw by hand, it will be realised that it requires a revolving movement as it is withdrawn, and the edges are very sharp and easily knocked away. Figs. 11 and 12 show a machine adapted for this purpose.

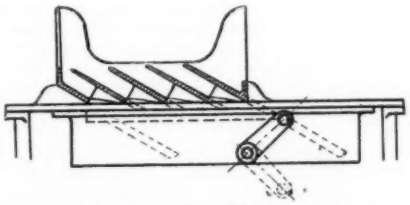


FIG. 13.—SHOWING THE METHOD OF STRIPPING A LOUVRE VENTILAR SLIDE.

There is no pattern plate in the ordinary sense; the pattern is fixed to this pin and is carried by a bracket, fixed to the movable part of machine. There is a slot in this bush at the necessary angle, in which a small pin, fixed to the larger one, engages, and this gives the revolving movement from the mould and through the stripping plate.

Louvre Ventilator Slide.—Fig. 13 shows another example where part of the pattern is stripped through the remaining part. The four blades are

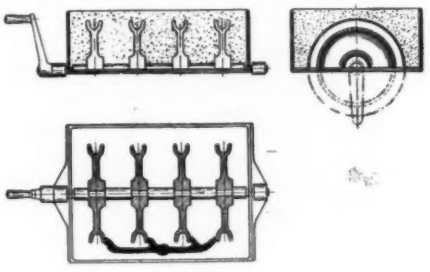


FIG. 14.—SHOWING A METHOD OF MAKING GROOVED PULLEYS.

withdrawn by one movement of this lever, the remainder of the pattern being withdrawn in the usual way by the lever of the machine.

Grooved Pulleys.—Fig. 14 shows a method of making grooved pulleys, the half-patterns are fixed to the spindle, and by the movement of the lever are revolved out of the mould on their own centre and through the stripping plate. This, of course, is also a reversible plate.

When this Paper was given before the Birmingham Branch specimen plates of the various types mentioned, some in the course of construction, and several sand moulds were exhibited.

THE INSTITUTE OF METALS.—The Council are now enabled to give further particulars of the previously announced annual autumn meeting which will take place in Birmingham on Wednesday, Thursday, and Friday, September 21, 22, and 23. A reception committee, presided over by Sir Gerard Muntz, Bart. (past-president), and of which Mr. Geo. W. Mullins is acting as honorary local secretary, and Mr. G. Bill-Gozzard as honorary local treasurer, has been formed and has drawn up an attractive preliminary programme. On September 21, at 10 a.m., there will be an official welcome of members by the Lord Mayor, and the remainder of the morning will be devoted to the reading and discussion of papers. After an official luncheon, a visit will be made to the University Buildings at Edgbaston, where tea will be provided. In the evening there will be a reception by the Lord Mayor. On September 22 the morning will be devoted to the reading and discussion of papers, and after luncheon there will be visits to works, the evening being devoted to a garden party or other entertainment. The concluding day of the meeting, Friday, September 23, will be available for a motor excursion to Warwick, Kenilworth, and Stratford-on-Avon. Sir Gerard Muntz has kindly offered to receive the visitors at his Stratford home to tea, this hospitality concluding the meeting.

Institution of British Foundrymen.

LANCASHIRE BRANCH.

Discussion on Mr. Bartlett's Paper on "Safety in the Equipment of Foundries."

MR. OLIVER STUBBS said he agreed entirely that there would be less accidents in foundries if more attention was paid to the points which had been reviewed by the lecturer, but however careful employers, managers, and foremen were, accidents would occur, but many might be obviated by the co-operation of the workpeople.

Gangways should be made a good width and no obstructions allowed, nor should moulding boxes be permitted to overhang. Lifting ropes of cranes should be periodically examined for signs of wear and should be kept greased. The use of slings is also a very important question, and a register should be kept of all slings in use; each sling should have its own distinguishing mark and the lifting weight stamped upon it. Also greater care should be given to the working angles of the slings and no knots should be tied in them. Also the sharp edges of castings and moulding boxes should be protected to prevent the cutting of the slings. Slings and chains must be periodically annealed and tested.

With regard to the lecturer's remarks upon rattlers or rumblers, he would suggest that in addition to having them in a separate department they should also, while working, be covered with a canvas cover which would keep the dust from spreading. There would be greater safety if the management took more personal interest in the workpeople, particularly the boys, and when they see anything being done in a wrong way they should point out the right way. The parents of the boys should see they were properly shod, and not allowed to come to their work, as frequently happens, in boots in very bad repair, and as a consequence, burns in this direction were very frequent owing to inadequate protection. The majority of the boys are quite willing to be shown, and one reason we are not getting the right class of boys in the foundry was that it was not made more attractive and sufficiently clean to induce them to come.

The speaker would like to know if Mr. Bartlett has had any experience of asbestos boots and leggings, particularly for the metal carriers.

MR. MASTERS asked about the extent to which Factory Inspectors exercised supervision in the foundry. In the whole of his career he had only seen one factory inspector in a foundry.

MR. STEVENSON said he remembered a Board of Trade inquiry was held in Manchester, at which Mr. Bellhouse was chairman. If the Safety First Association would apply to the Board of Trade no doubt they would be supplied with a lot of information, especially as to the accidents which occurred in Lancashire. He believed it was after such an inquiry that spats came into use: whether they originated then he could not say, but a great feature was made of them. In one place the men casting were supplied with leather breeches extending from the hip to the shoe.

MR. J. HAIGH said the lecture was a common sense one, and would perhaps remind members of things which they had neglected. He agreed that the larger number of accidents in foundries were due to carelessness. At the foundry he was connected with, notices were posted up directing that no ladles were to be taken away which were filled to less than four inches from the brim, but it was not easy to get the men to comply with the rules. Every chain and wire rope had a number and limits were laid down as to when they had to be thrown out. Much time was lost by minor accidents because the boys would not report little injuries so that they might be attended to at once; the firm had had to insist upon all accidents being reported. Asbestos leggings, the men said, became very hot when used for any length of time. Respirators were also supplied, but the men discontinued to use them after a short time. It seemed to him it was very necessary to educate the men in the use of safety appliances, and he suggested it would be a good plan to call them together and discuss these things. He remembered at the Board of Trade inquiry in Manchester, representatives of the trade unions were present, and a lot of evidence was accumulated, but the result of the investigation was that the Authorities were not in a position to recommend the compulsory adoption in foundries of any of the things suggested. He quite agreed that if a better class of boys was to be brought into the foundries there must be an improvement in the conditions.

MR. J. HOGG said the most dangerous thing he had seen in foundries was snatching metal at the cupola. At the foundry he was connected with they were now using a runway, which cost about £27 provided with a pulley block on ball bearings for carrying the ladle, the weight lifted being 15 cwts. They ran the ladle under the furnace spout, it quickly filled, and the men were waiting for it with their shanks on either side of the gangway. As it went by, the metal was poured into their shanks. He did not think there had been any case of burning during the last two years. Men were not allowed to get metal at the cupola unless there was an urgent reason.

MR. A. L. KEY said rule-of-thumb methods were responsible for many accidents. Whatever rules and regulations were devised safety could not be secured without the co-operation of the employees, yet the very people whom it was sought to benefit were the first to infringe. The manager could not watch every part of the shop.

MR. H. SHERBURN said if warning notices were put up all over the foundry prospective workers might be led to think it was a very dangerous place in which to work. There was some liability to accidents from burns, particularly in the light casting industry, where shanking was practised, but when one came to consider the whole matter, in view of the large number of people employed in handling small quantities of molten metal, the accidents in this connection were remarkably few. The only way in which any good could be done was through co-operation between the management and the workers without prejudice. Any suggestion from the side of the management in this connection was generally received with coldness. The wearing of spats would be an admirable preventive of many accidents if the men could be persuaded to wear and look after them,. but even if a start was made he believed in three months they would have to begin again. Advertisements in some of the American papers recommended the use of specially designed boots that were perfectly safe; but how were people to be made to use them. It was a delicate matter, and he did not know that it could be done except by a Board of Trade Regulation. Anything in the way of safety appliances must not make the foundry more unattractive than it was to-day when it was in many cases overloaded with unattractive features.

The Author's Reply.

MR. BARTLETT, replying to Mr. Stubbs, stated that asbestos leggings were unnecessary at the foundry with which he was connected as the tapping was always done with a long bar 9 or 10 ft. long, thus making the tapper stand a long distance away from the cupola. For workmen required to carry molten metal spats were provided, which were put on under the trousers and over the boots, thus it did not matter how bad the boots were or how badly laced.

A good deal of difficulty was at first experienced in persuading the men to use spats. As a rule the first thought of the men was, "what is the firm going to get out of it?" But when it was pointed out that it was the men who suffered most from the neglect of such precautions they were willing to wear the spats. At present the only trouble he had in connection with that was that the spats sometimes disappeared.

Answering a further question, Mr. Bartlett stated that a record was kept of all accidents, and they followed up the cause to see what could be done to prevent a recurrence. He was expecting to get into touch with the British Industrial "Safety First" Association to see if he could assist them. He thought that Association had some difficulty in getting into touch with the foundry world.

Replying to Mr. Masters' question, the lecturer said the standing order of the Board of Trade was that any accident caused by moving machinery

must be reported within 24 hours. There was very little moving machinery in a foundry, so the factory inspector had not much inducement to make repeated visits.

Prevention was better than cure, and experience showed that danger signs were of service in reminding people of what they were liable to forget and he had not found that they caused any trouble. At his factory every chain was tabulated on a sheet, which set out the safe load, and there were charts showing the angles at which the loads should be swung. Every slinger and foreman in the shop had one of those charts in pocket form, and they were also placed in conspicuous positions in the shop.

The lecturer added that safety appliances were readily used in America because of the number of foreign workers who did what they were told. To his mind leggings were dangerous, because if the metal got in at the top there was no chance for it to get out, thus giving a very severe burn. It was better to have spats, some of which had been in use for about 15 years, under the trousers because the metal did not as a rule burn through the cloth. It was the duty of the members to influence the workers in this matter and educate them into an understanding of the necessity for these appliances and the best methods of using them. Of course, it was also to the interest of the employer.

Wood versus Iron Patterns.

By F. C. EDWARDS.

When large numbers of castings are required off a pattern which, if made of wood, would not last, the usual practice is to make one or more metal patterns. Before adopting any method of making a working pattern, three essentials should be considered:—(1) The shape, thickness, etc., of the pattern. (2) The number of castings required. (3) The relative weights of wood and iron patterns.

In addition to the above it must not be forgotten that the pattern has to be withdrawn from the mould perhaps a score or more times every day it is worked: and human fatigue sets in with excessive work, and fatigue militates against efficiency. We fail to see the wisdom of making an iron pattern to endure ten years; if it is so heavy and awkward to handle, that production is hindered 10 per cent. every day.

Some patterns are so thin and fragile that, however skilfully they may be constructed, it would be absurd to mould off them except with the object of making metal patterns, and then the greatest care is required in ramming up to avoid distortion. Indeed, the thin plate, frame, and light bent patterns may be regarded as the correct types of which it is imperative to make metal patterns.

When a pattern is fairly stout, and can be so built up that it will neither warp nor swell with constant use especially if it is of a tolerably plain shape, a wooden pattern—though it has to be replaced by a new one periodically—is generally the most satisfactory from all points of view.

One of the most glaring instances of the iron-pattern fetish came under the writer's observation during the war. An order was booked for several thousand mine-sinkers, the baseplates of which were of cast iron, weighing, say, four to five cwts. each, and measuring about two feet wide and three feet long. There was a rib all round four inches deep, and several facings, etc., for the reception of brackets. The time allowed for the execution of the order was very limited, and an iron pattern was decided upon.

A wooden pattern was made which allowed double contraction, i.e., it was sufficiently large to permit shrinkage from the wooden pattern to the iron one, then another contraction from the iron pattern to the iron casting. When the final casting was obtained it was found to be too heavy by about 60 lbs. The plate, instead of being ¾ in. thick was over ⅞ in.; the ribs had likewise grown in thickness. This was, of course, principally due to the double dose of rapping which had been administered to the patterns. And as moulders generally have less compunction in punishing an iron pattern than a wooden one, the trouble would thereby be aggravated.

The excess thickness could certainly have been obviated by making the original pattern so much smaller in thickness all over, and, even at this late stage, it was suggested that this should be done. The writer objected to this course, and, as an alternative, proposed to make several wooden patterns, which he maintained would give complete satisfaction, besides expediting the execution of the order. This course was agreed to, and an immediate start was made. After deciding which men to put on the patterns, the writer considered it advisable in order to secure uniformity and excellence of construction based upon the general consensus of opinion, to discuss the whole job, with the men concerned, as a preliminary measure.

It was decided to "frame-up" the plate out of yellow pine and eliminate the risk of warping which would have been present had mahogany or other strong-grained wood been used; the centre to be "panelled" and "open" joints, thus neutralising the effects of heat and moisture by localising contraction and expansion of the timber. The sides—which were 4 in. deep—to be of mahogany and to extend the full depth. This would ensure that the edge of the frame did not recede from, or project over, the sides under the influence of heat or moisture; the pine frame was thus completely enclosed. The facings, etc., were also to be of mahogany. Every step was discussed in the order in which it would actually be proceeded with, and debatable points thoroughly thrashed out until a general agreement was reached. In this way the image of the pattern in its various stages of development and final completion was impressed on the minds of the several pattern-makers. Finally, as all the patterns were to produce identical castings, it was decided to fix responsibility by casting a small figure on each as a mark of identification.

The result more than justified expectations, and proved the soundness of the principles enunciated above. The patterns, having received several coats of varnish, with corners well rounded, and hollow fillets in all corners, commanded the respect of the moulders. Even machined faces were slightly rounded at the corners, for, as the writer pointed out during the discussion, seeing that it had to be machined away again a small round would be no detriment to the casting, and would tend to make the moulders' task lighter—there being less likelihood of the mould being disturbed by a "round" as by a square corner.

A great advantage which the wooden patterns possessed over the iron one was that whereas it required the combined strength of several men—or of a crane—to lift the iron pattern, weighing 4 cwts. from the mould, two men could easily withdraw the wooden pattern with less risk of the mould being disturbed by uneven lifting.

The patterns came out of the sand with the slightest rapping, and the moulds were scarcely touched with a tool consequently the variation in the castings was inappreciable. With an occasional rub down and new coat of varnish the patterns were kept up to their original excellence, and, when the order was completed, after several hundred moulds had been made from each, they were by no means worn out. There had been no waiting for castings, and the initial cost of the patterns had been defrayed many times over by the increased output, and uniformity of production.

As stated at the commencement of this article, each case must be decided with reference to its own peculiar merits or de-merits, but the writer's experience of many years in wood and iron patterns has yielded a host of examples—similar to the one given above—proving that an iron pattern, though the obvious remedy for mass production should not be resorted to until a well-constructed wooden pattern has been considered. Lightness and ease of handling may turn the scale in favour of a wooden pattern when fairly compared with an intractable, though strong, iron pattern. Strength is but one of several factors to be considered, and, where present it does not invariably connote durability.

Trade Talk.

Two of the mills at Messrs. Lysaght's new works in Newcastle, Australia, have been started.

SIR W. G. ARMSTRONG, WHITWORTH & COMPANY, LIMITED, have acquired certain mineral interests in Argentina.

THE imports of foreign ore at the Senhouse Dock, Maryport, during May have been 3,500 tons, against 18,500 tons this time last year.

THE headquarters of the Associated Society of Locomotive Engineers and Firemen, which have been in Leeds for 41 years, are to be removed to London.

THE Council of the Institution of Electrical Engineers, at a meeting last week, decided to apply to the Privy Council for a Royal charter of incorporation.

THE wages regulated by the sliding scale under the Midland Iron and Steel Wages Board will be reduced 35 per cent from Monday, June 6, to Saturday, August 6.

THE BRITISH ELECTRICAL MANUFACTURERS' ASSOCIATION has sent a protest to the Sydney (N.S.W.) Municipal Council for accepting an Australian tender for electrical plant 20 per cent. over a British tender.

AMONG goods which may now be exported from France without a licence subject to the payment of export duties, if any, are Bauxite and iron ore, including residue from the roasting of pyrites.

H.M. TRADE COMMISSIONERS in South Africa have recently been considering the question of attracting young South Africans to engineering and other technical colleges and training establishments in the United Kingdom.

A SURPLUS of $518,280 for the first quarter of 1921 is reported by the American Steel Foundry, after the deduction of all charges and Federal taxes. This surplus is equal to 60 cents per share on the common stock of $20,401,000 outstanding.

BARROW engineers at a mass meeting on the 30th ult. passed resolutions asking the Executive to oppose reductions in wages, and supporting the attitude of the Executive on the question of overtime manning of machines and the employment of apprentices.

A NEW graving dock is to be constructed in the port of Sunderland by Messrs. T. W. Greenwell & Co., Limited, a local firm of engine repairers. The dock will be 550 feet long and 71 feet wide at the entrance, and will be able to accommodate the largest vessels built on the Wear.

AN international exhibition will be opened at Belgrade this month, under the auspices of the Museum of Industry and Commerce of that city. The Serbian Government has placed at the disposal of the promoters an area of about five acres, and the necessary work is in progress.

OWING to an error in the printing of the conditions endorsed upon the certificates of the 8 per cent. convertible debenture stock recently issued by the Leeds Forge Company, it has been found necessary to cancel the existing certificates and replace them with others, which are now ready for issue.

AN issue of £2,250,000 7½ per cent. mortgage debenture stock of Baldwins, Limited, is to be made shortly at £95 per cent. Among other features repayment is provided for by the establishment of an annual cumulative sinking fund involving annual drawings at £100 or by purchase in the market below par, the whole to be repaid not later than 1950.

IN an address before the American Iron and Steel Institute recently, Judge Gary, chairman of the United States Steel Corporation, declared that the present selling prices of steel would not permit of any reduction until there was a further decrease in wages. Mr. Charles Schwab urged the need for economy in the costs of labour and transportation.

THE members of the North of England Institute of Mining and Mechanical Engineers at their meeting in the Wood Memorial Hall, Newcastle-on-Tyne, on June 4, discussed the following papers:—"The Production and Transmission of Compressed Air in Mines," by Mr. J. T. Pringle; "A Self-acting Jig, with Intermediate Landings," by Mr. E. W. Milburn.

MESSRS J. C. BISHOP and O. Coyle, joint secretaries of the Scottish Manufactured Iron Trade Conciliation and Arbitration Board, have been informed by the accountants that they have examined the employers' books for March and April, 1921, and certify the average net selling price brought out at £23 14s. 7.8d. This means a decrease in the wages of the workmen of 40 per cent. on basis rates.

SIR DAVID SHACKLETON received at the Labour Ministry on the 31st ult., a deputation from the Engineering and General Workers' Unions regarding the proposed reduction in wages. The proposal is to reduce the wages of skilled workers by 15s. 11d. per week, semi-skilled by 14s., and unskilled by 13s. The proceedings were private. The deputation requested that the reduction proposed should be submitted to the Court of Inquiry under the existing Act.

THE formal opening of the recreation grounds in connection with Messrs. Baldwin's Panteg Works took place recently. It is at these works that a proportion of the basic slag and the Nauru phosphate will be ground to produce the slag phosphate, in the form which the Nauru phosphates will be sold to the British farmer. This development is part of the enterprise of the South Wales Basic Slag Company, Limited, of which Mr. G. V. Parker is managing director.

DURING May an exceptionally small number of vessels were launched on the Clyde, and the tonnage is the lowest this year. The total production consisted of 18 vessels, of 18,808 tons, but of these only four were general trading vessels. The five months' aggregate consists of 101 vessels, of 191,485 tons, as compared with 75 vessels, of 244,697 tons last year, and 105 vessels, of 293,997 tons, in the first five months of 1913. No new orders have been announced for a long time

A STRIKE consequent upon another proposed wages cut has been declared by the members of the National Union of Foundry Workers, at the works of Flavel & Company, Limited, Leamington. Some time ago prices for moulders had been agreed upon, but after a while the firm suggested a reduction, and after a discussion the men agreed. The firm have now asked for a further cut of 10s. a week, but the men claim that the prices offered do not compare with those offered by other firms for similar work.

AT the thirty-first annual meeting of the Federation of Engineering and Shipbuilding Trades, at Scarborough, two societies were admitted to affiliation—the National Union of Stove, Grate and General Metal Workers and the Tinplate Workers' and Braziers' Society of Birmingham. In the course of discussion various trades took the view, which was supported by the Federation, that the question of apprentices' wages must be dealt with from a national standpoint in the same manner as men's wages.

THE E. W. HARVEY GAS FURNACE COMPANY, LIMITED, of 70, Victoria Street, Westminster, S.W.1, have recently commenced the building for David Colville & Sons, Limited, of four large slab heating furnaces, with combined gas-producers and coal feeding plant, and with all the latest improvements, for serving a new plate mill at their Clyde Bridge Works, Cambuslang. This makes eight Harvey-Siemens furnaces built for slab heating and other purposes at Messrs. Colville's works.

REFERRING to the recent sale of the Port of Richborough by the Government, we understand that all the craft lying at Richborough, with the exception of the vessels actually required for the working of the port, have been acquired by Crichton, Thompson & Company, Limited, and are for disposal. As they were unable to extend their present office accommodation at 17-19, Cockspur Street, S.W., Crichton, Thompson & Company, Limited, have taken over additional offices at 11, Haymarket, S.W.

THE British Consulate at Malaga reports that a hematite property in the South of Spain, covering some 665 acres and estimated to contain 4½ to 6½ ft. thickness of seam of analytical content of 48 to 55 per cent. iron, 3 to 6 per cent. manganese, slight traces of phosphorus and sulphur, but no arsenic or copper, is offered on a royalty basis for a term of years. Further particulars may be obtained by United Kingdom firms on application to the Inquiry Room of the Department of Overseas Trade, 35, Old Queen Street, Westminster, S.W.1.

A SUBSTANTIAL cut in the wages of foundry workers is proposed to be given immediate effect to by the National Light Castings Ironfounders' Federation, who have announced their intention to the Executive of the Central Ironmoulders' Association. The employers' proposal is that commencing with the first pay day in June the wages of daysmen shall be reduced by 6s. per week with a corresponding reduction on piece-work rates of 15 per cent. A further reduction on daysmen's wages of 12½ per cent. and on piece-work rates of 7½ per cent. is proposed to be given effect to as from the first pay day in July.

THE report presented to the members at the annual meeting of the Birmingham Metallurgical Society (Mr. A. Spittle, president, in the chair), at the Birmingham Chamber of Commerce, showed that the Society's activities during the last session had been progressive. The membership at that date had reached the total of 874, showing a net gain on the previous session of 44. During the session 11 papers had been read before the Society, of which five had been given by members, and these had all proved of an interesting and scientific value. The second annual award of the Society's bronze medal and prize was made to Mr. C. W. Yearsley, Burslem, for his Paper on "A Physico-Chemical Interpretation of the Effects of Strain upon Metals." The president elected to the chair for next session is Mr. F. Johnson, Mr. F. J. Cook being elected a vice-president. The following members were elected to the Council:—Mr. W. R. Barclay and Mr. A. E. Smith (Birmingham), and Mr. C. Carter and Mr. L. P. Wilkes (Wolverhampton).

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IRON AND STEEL MARKETS.

Pig-iron.

It is significant of present-day conditions that the Derbyshire pig-iron smelters are asking a further premium of 10s. per ton on their basis rates. This makes a total premium of 30s. per ton since the coal strike commenced, and No. 3 of that make is now selling at 170s. to 180s. at the furnaces. No. 3 Scottish foundry iron is also at 170s., so that No. 1 Cleveland foundry iron is still relatively cheap at 130s per ton, which is only 10s. above the minimum. There is not likely to be much obtained at that figure, for production has ceased, and stocks of all foundry qualities are almost exhausted. Still the makers are anxious to avoid the evils attendant upon inflation, and are quoting 10s. premium, home prices being: No. 1, 135s.; No. 3 Cleveland G.M.B., 130s.; No. 4 foundry, 129s. per ton, with export prices 5s. above the home figure. The position in regard to the lower grades is vastly different. Supplies are plentiful, and sellers eager to unload stocks, but the demand is small, although forge and mottled iron is offered at 117s. 6d. per ton, and white iron at 115s. East Coast hematite is in very poor demand, and it is freely offered at 160s., which is the official minimum for mixed numbers. But the export trade is free, and, with competition keen, makers have cut prices to 150s., or even lower, without attracting any substantial volume of business. Production in the Midlands is idle, the foundries buying very sparingly, some of them having more pig-iron than they can see their way to turn into castings for an indefinite period, the depletion of reserves at furnaces encouraging sellers to follow up the advance which has lately taken effect. But there is not enough business passing to afford any real test of the strength of the position, and users will only buy what is necessary for their immediate needs. So far as forge sorts are concerned, the market is idle. In the West of Scotland the small stocks of foundry iron in the hands of the makers have almost come to an end, but several buyers taking an optimistic view of the future are acquiring iron for forward delivery under the belief that prices will not show any further fall, however soon the strike may be settled. The downward movement of European exchanges is also, no doubt, having a favourable effect, as any continuance of this movement would undoubtedly result in enhanced prices being asked by Continental sellers. Scottish makers' prices remain unchanged. with No. 3 163s. 6d. to 170s.; No. 1, 167s. 6d.; to 175s., on trucks makers' works. Hematites, 1, 2, 3, 180s. to 190s., consumers' works.

Tinplates.

The tinplate market continues to be in a most depressed condition, and there are no apparent signs of any improvement. All the works have been reduced to idleness by the coal strike stoppage. There is not much inquiry, and prices are very "wide." Some of the makers will use Continental bars, and are willing to book at round 25s. 6d. to 26s. basis for cokes, for forward delivery, while other makers are asking 28s. to 30s., but there is very little buying even at the lower figure. The outlook is certainly not bright just now. Stock lots continue to change hands at 25s. to 26s. basis. Wasters are in quiet but steady request. C.W. 14 x 20 are realising round 21s. 6d.; C.W. 28 x 20, 40s. per box; C.W. 14 x 18, 20s. per box; C.W. 20 x 10, 29s. per box, all net, f.o.t. at works.

Finished Iron.

Production of finished iron is practically suspended until normal fuel supplies are available while markets are simply marking time pending the revival of an active demand. Business now offering is essentially of a tentative nature, prospective purchasers negotiating on the basis of prices ruling at the date of delivery, a form of speculative trading not entirely satisfactory to either party to the transaction. This is, however, the only possible basis on which any trade can now be done, although it leaves things in great uncertainty, and presumes lower prices in the future. No doubt it would be quite well justified in connection with marked bars, which, it is understood, will be reduced substantially as soon as the strike ends, but in other materials it leaves matters largely to chance. There is still a certain tonnage of orders for finished material going to Belgian and French works, but the greater part is for small lots and prompt delivery. Consumers are buying only for their immediate requirements, and as the paralysis caused by the strike spreads, these needs diminish. In a few lines American competition has re-appeared, and the re-arrangement of the tax on imported German material has brought a few tentative orders from German works into the market. Apart from a few unimportant sales from stock, business in the finished iron trade on Tees-side is stagnant, and all the works are closed down. But there is a considerable volume of orders, held up during the prolonged coal stoppage, which will have to come out immediately work is resumed. There has been no recent change in quotations.

Steel.

Business in all departments of the British steel trade is now actually at a dead end, and even the most optimistic observers do not anticipate any immediate revival of trade sufficient to find occupation for all the big open-hearth furnaces which were erected in Sheffield and the surrounding district during the war. So far, Sheffield makers have experienced a fairly good seasonal demand for agricultural and garden tools, but complaints are heard of the poor trade done in steel parts usually supplied in large quantities to Lincolnshire firms. Makers of electrical equipments and apparatus have a fairly good business in hand, but the big armament firms have little prospect of re-starting mills and forges in the near future, owing to curtailment of expenditure on naval and military requirements. The British Engineering Standards Association has received in six parts report No. 24, relating to rolling-stock material for railways. A modification of the existing standard specifications of considerable importance to the steel trade is the permission to use basic open-hearth steel in certain alternative specifications for axles, tyres, and springs, and also in the specification for steel plates, angles, and rivets for locomotive boilers. Another modification is an increase in the maximum permissible content of sulphur and phosphorus. The latter subject was considered by the Committee, at the request of the Ministry of Transport.

Metals.

Messrs. Henry Bath & Son, Limited, in their fortnightly metal report under date June 1, write:—With trade almost at a standstill it is difficult to account for the price movements in the metal markets or to foretell the future with any degree of accuracy. Hopes are centred on a strong demand arising when the coal strike is over and trade has a chance to revive, and much of the buying during the past fortnight has undoubtedly been in anticipation prompted by the conviction that prices are all on a reasonable basis. Continental countries are making greater strides in the resumption of production, manufacture and of general trade than this country is to-day, and in some respects have been lately our best buyers for most metals and ores.

Copper.—After the Whitsun holidays the market opened at a slight advance, which reached £1 a ton at the close of the day. The improvement continued until the 23rd ult., when £75 15s. was done for three months copper. Since then the market developed a tired aspect, and with small fluctuations drifted downwards. It will be observed that cash no longer commands the premium over forward that ruled at the close of our last report. The home demand is very small indeed, as owing to lack of coal many of the large works are at a standstill.

Tin.—The advance reported in our last continued with small fluctuations until the 23rd ult., when £194 5s. cash and £185 three months were paid. Since then, however, the market has declined steadily some £10 a ton. A better tone has since been discernible, but later the improvement was more than lost.

Lead.—A recovery took place in this market at the commencement of the fortnight, and £24 12s. 6d. prompt, £24 10s. forward were done on the 19th ult. Since then, as in other markets, liquidation ensued, consumers selling at the higher price, but inclined to buy back at the lower level.

Spelter.—In the first few days of the fortnight this market steadily advanced until £28 5s. prompt and £28 15s. forward were touched on the 20th ult. Prices since then have given way but slightly with May delivery at a premium over June. Consumers have been buying fairly well, while supplies from Germany and Belgium have been interfered with by the difficulties associated with finance, the troublous state of Silesia, and the improvement in the Belgian exchange.

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Pneumatic, Hydraulic, Jar Ramming, & Hand Power.

Type "A" Duplex Machine for Pneumatic Power.

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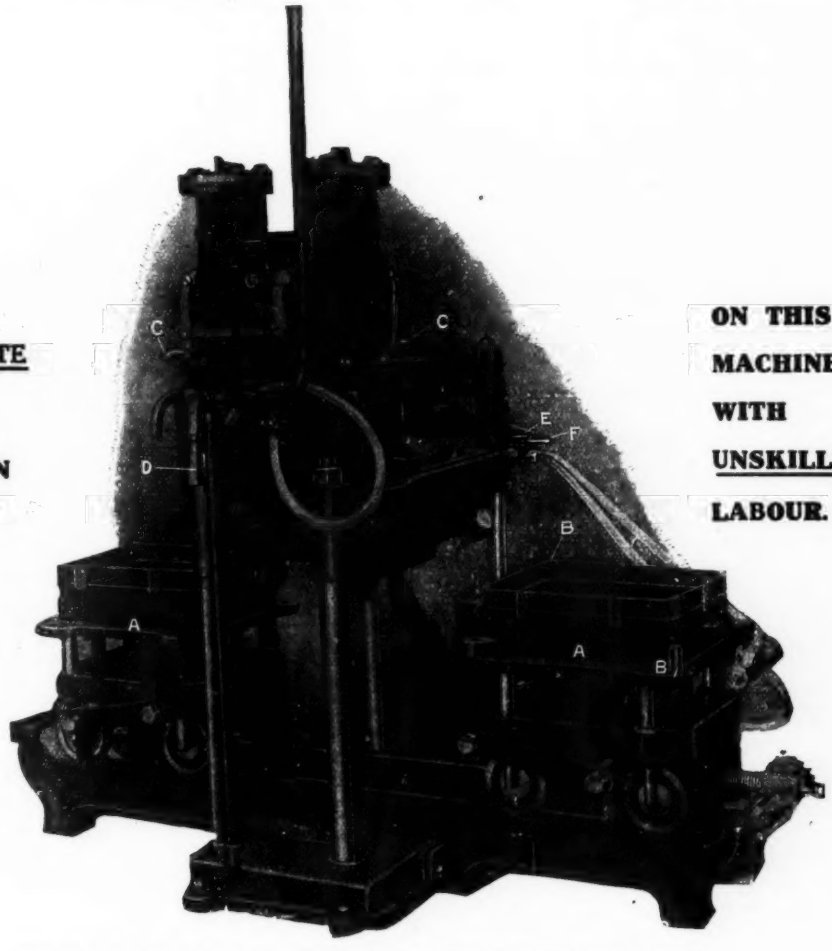
OVER 50 COMPLETE MOULDS PER HOUR HAVE BEEN PRODUCED



ON THIS MACHINE WITH UNSKILLED LABOUR.

One of many that we have installed in various Munition Work Centres.

JAMES EVANS & CO., BRITANNIA WORKS, BLACKFRIARS, MANCHESTER.

Gazette.

MESSRS. N. WARWICK & A. WALKER, electrical engineers, 107, Church Road, Birkenhead, trading under the style of Warwick & Walker, have dissolved partnership.

MESSRS. W. LAVELLE and G. Paul, engineers and ironfounders, Bastwell Engineering Works, William Herbert Street, Blackburn, trading under the style of Lavelle & Paul, have dissolved partnership.

THE partnership heretofore subsisting between Messrs. A. Sever and R. L. Van-Hixe, mechanical engineers, Falcon Works, Portugal Street, Oldham Road, Manchester, under the style of Falcon Engineering Company, has been dissolved.

Personal.

SIR EDMUND WYLDBORE-SMITH has been elected to the position of chairman of the Metropolitan Carriage, Wagon and Finance Company, Limited.

SIR GILBERT CLAUGHTON, BT., has, owing to failing health, resigned the chairmanship of the London and North-Western Railway Company, and the deputy-chairman, the HON. Charles Napier Lawrence, has been elected chairman in his stead. Sir Gilbert retains his seat on the board.

MR. T. DONALD, M.P., and Mr. J. A. Dufs, M.P., who have been elected to represent East Belfast in the new Ulster Parliament, are both intimately associated with the engineering and shipbuilding industry in the city.

MR. R. B. MCCOLL, on his retirement from the post of general manager of the locomotive works of Sir W. G. Armstrong, Whitworth, & Company, Limited, was entertained recently by the officials and foremen of the department, who showed their appreciation of their late chief by making him the recipient of a handsome presentation.

MAJOR JOHN LAURENCE BENTHALL, C.B.E., T.D., a director of Vickers, Limited, has had conferred upon him the highest honour which is bestowed by the Emperor of Japan, the Order of the Rising Sun, 3rd Class, "for services rendered to the Japanese Navy both during the war and previous to it." Major Benthall is the director in charge of the armour-plate departments of Vickers' Sheffield works.

Deaths.

MR. J. TAYLOR, of the Clay Mills Ironworks, near Burton-on-Trent, died recently, aged 71 years. Mr. Taylor went to the works 47 years ago, and had been general manager for 39 years.

MR. S. HEEPS died at Ashbank, Polmont, on May 27. The deceased gentleman was the manager of the Summerford Iron Company, Falkirk, and was the son of the late Mr. Simon Heeps, Woodside, Polmont.

MR. G. KYTE, retired engineer, died at his residence, 1, West Grove, Newport Road, Cardiff, on May 27, aged 74 years. A native of Portskewett, he went to Cardiff 40 years ago, and started in business as an engineer and iron founder, at the Mill Lane Foundry.

M. PAUL FOURNIER, the general manager of the famous Schneider works at Le Creusot, was proceeding on Saturday night last in his motor-car to Caen steel works, when, at a level crossing, the car was caught by the Paris-Caen express and smashed to pieces. Both M. Fournier and his chauffeur were killed.

IT is with regret that we announce the death of Mr. Edwin Lancelot Orde, local director and commercial general manager of the Shipyard Department of Sir W. G. Armstrong, Whitworth & Company, Limited, which took place at his residence, 15, Basil Mansions, Knightsbridge, London, on Friday, May 27.

Company News.

Centrifugal Separators, Limited.—Balance at debit of profit and loss account, £5,935.

Stanton Iron Works Company, Limited.—Final dividend, 8 per cent., making 14 per cent., free of tax, for year.

Electric Construction Company, Limited.—Final ordinary dividend, 9 per cent. per annum, making 7½ per cent. for year; bonus, 2½ per cent.

The Mint Birmingham, Limited.—Ordinary dividend for half-year of 5s. per share, making 10 per cent. for year; bonus, 35s. per share for year, both free of tax.

Aster Engineering Company, Limited. — Available balance, with amount brought in, £57,165; ordinary dividend, 7½ per cent., free of tax; carried forward, £40,573.

Metallic Seamless Tube Company, Limited. — Net profit, £10,191; brought forward, £29,815; issue of bonus shares, £26,000; interim dividend on preference, £213; ordinary dividend, 10 per cent. for year, free of tax; carried forward, £8,379.

Pease & Partners, Limited. — Profit, £528,579; brought forward, £125,175; debenture interest, £23,267; interim ordinary dividend, 7½ per cent. (free of tax), £163,979; special expenditure, £69,165; reserve for reinstatement of collieries, mines and other works after stoppage, £100,000; fund for betterment of social conditions of employés, £10,000; final dividend, 6½ per cent. (free of tax), making 14 per cent. (free of tax) for year, £142,115; carry forward, £145,225.

MISCELLANEOUS advts., see also page **16.**

Large quantities BALL BEARINGS (new and second hand).
SPECIFICATION STEEL, ⅝ in. to 1¾ in.
HIGH SPEED and CARBON DRILLS, ¾ in. to 2 in. (all new).
HIGH SPEED REAMERS, 21/64 in. to ⅞ in. (all new). On view any time.
SIMOON ENGINEERING,
Bramber Road, London, W.14.

ORDERS WANTED for small Machine-made Castings in Brass, Gunmetal, Phosphor, or Manganese Bronze. Also Castings any size up to one ton in weight. Prompt delivery.—JAMES G. CROWTHER, Paradise Street Brass Foundry, Sheffield.

CASTINGS (IRON) ORDERS WANTED for any weight and size (Yorkshire District). Machined if necessary.—Address, Box 728, Offices of the FOUNDRY TRADE JOURNAL, Bessemer House, 5, Duke Street, Adelphi, London, W.C.2.

WE Specialise in Aluminium Castings, die and sand. Enquiries solicited. Prompt deliveries. Also Castings in Brass, Gunmetal and Phosphor or Manganese Bronze.—H. PERKS & COMPANY, The Foundry, Stanley Road, South Harrow.

FIREBRICKS.—Best Stourbridge Firebricks and Fireclay, at exceptionally low prices, delivered by truck or van.—YOUNG & SON, Rosher's Wharf, Kingsland Road, E.8.

MILD STEEL ANGLES, PLATES, JOISTS, ROUNDS, BILLETS, PIG-IRON, ETC.

Our Prices and Deliveries are Right.

CUNNINGHAM CRAIG & COMPANY,
147, Bath Street, Glasgow.

ENQUIRIES SOLICITED FOR CASTINGS IN IRON, machined or unmachined, up to 5 cwt. Complete Machines built throughout to specification, singly or in quantity. Jig and Tool Work a speciality.—C. S. PEATFIELD, LIMITED, Market Rasen, Lincs.

PATTERNS and CASTINGS SUPPLIED WHICH GIVE SATISFACTION. Inquiries solicited. Quotations by return of post or telephone. You can secure good-class work, reasonable prices, and promptitude in delivery by placing your orders with VIDEX PATTERN WORKS AND FOUNDRY, Huntsworth Mews, Upper Baker Street, London, N.W.1. (Telephone, Paddington 364).

FOR SALE, cheap, Foundry Pig-iron, all sections F.B. Steel Rails, with all accessories; Joists, Channels, Angles, Sheets and Plates, all thicknesses; plumbago.—ASCOG, Golder's Green, London. Telephone; Hampstead, 1806.

WE Specialise in FANS and FAN WORK for Foundries. H.P. Fans and Blowers for Smiths' Hearths, Cupolas, Oil and Gas-fired Furnaces, Dust Extraction Fans for Fettling Shop and Sand Blast, Ventilating Fans for Fumes, etc. Worm-geared Pulley Blocks, 10 cwt. to 10 tons.—PROGRESSIVE ENGINEERING COMPANY, LIMITED, Leicester.

PATENTS.

ADVICE and Handbook Free. — KING'S PATENT AGENCY, LIMITED, Director, B. T. King, Reg. Patent Agent, 146a, Queen Victoria Street, E.C.4.

E. J. & J. PEARSON, LTD.

Blast Furnaces
Stove Bricks
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Producer Linings
Coke Ovens
Boiler Settings

STOURBRIDGE

CASTINGS MADE RUSTLESS

Write for Particulars.

The Rustless Iron Co., Ltd.,
Trico Works,
KEIGHLEY.

GENERAL REFRACTORIES CO., LTD.,
SHEFFIELD.

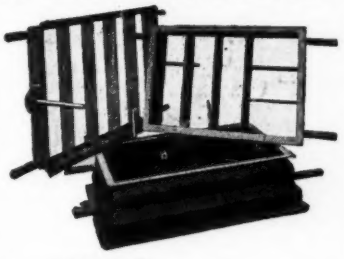
MOULDING SANDS
For STEEL, IRON, and BRASS.

GROUND GANISTER
OF ANY QUALITY
For CUPOLAS, LADLES, &c.

'Phone 3577 (2 Lines). Telegrams: REFRACTORY.

SHEET METAL & GALVANIZING CO., LTD.,
SPENCER ROAD, LIDGET GREEN, BRADFORD.

Improved Sliding Bar for Foundry Flasks.
Patent applied for.



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TO ANY SPECIFICATION.
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The "EYRE"
System of Liquid Fuel Burning
(INCORPORATING THE HOVELER PATENTS).

Applicable to all Foundry Uses, including:
DRYING OF LADLES . . . .
HEATING OF CORE STOVES.
ANNEALING FURNACES. . .

BOILER WORK A SPECIALITY.

In Use 14 Years. *Write, 'Phone, Telegraph or Call:*
THE EYRE SMELTING CO., LTD.,
MERTON ABBEY, LONDON, S.W.19.
Telegrams: ANALYZING, LONDON. Telephone: WIMBLEDON 604 and 605.

WEEKLY PRICE CURRENT.

COPPER.

	£	s.	d
Standard cash	72	15	0
Three months	73	5	0
Electrolytic	76	0	0
Tough	73	10	0
Best selected	74	0	0
Sheets	116	0	0
India	116	0	0
Wire bars	76	10	0
Do. June	76	10	0
Do. July	76	10	0
Ingot bars	76	0	0
H.C. wire rods	83	0	0
Off. aver. cash, Apr.	69	8	11⅜
Do. 3 mths., Apr.	69	9	2⅝
Do. Settlement Apr.	69	8	6⅞
Do. Electro, Apr.	72	16	2⅜
Do. B.S., Apr.	71	6	8
Aver. spot, copper, Apr.	69	7	10¼
Do. Electro, Apr.	73	16	8

Solid drawn tubes .. 15½d.
Brazed tubes .. .. 15½d.
Wire .. .. .. 12d.
Yellow metal rods .. 8¾d.
Do. 4x4 Squares .. 10½d.
Do. 4x3 Sheets .. 10½d

BRASS.

Solid drawn tubes .. 13½d.
Brazed tubes 16½d
Rods .. .. .. 12½d.
Sheets to 10 w.g. .. 12d.
Wire .. .. .. 11⅞d.
Rolled metal .. 11½d.

TIN.

	£	s.	d
Standard cash	165	15	0
Three Months	167	0	0
English	163	0	0
Bars	165	0	0
Chinese	158	15	0
Straits	166	15	0
Australian	167	5	0
Eastern	176	10	0
Banca	171	15	0
Off. aver., cash, Apr.	164	0	11⅜
Do. 3 mths., Apr	166	19	4½
Do. Sttlment., Apr.	164	0	0
Aver. spot, Apr.	163	19	3½

SPELTER.

	£	s.	d
Ordinary	26	10	0
Remelted	22	15	0
Hard	16	0	0
Electro 99.9	35	0	0
English	32	0	0
India	22	0	0
Prime Western	27	15	0
Zinc dust	50	0	0
Zinc ashes	6	0	0
Off. aver., Apr.	26	1	5½
Aver., spot, Apr.	25	10	7

LEAD.

	£	s.	d
Soft foreign ppt	22	15	0
English	23	15	0
Off. average, Apr.	20	16	10½
Average spot, Apr.	20	11	9½

ZINC SHEETS.

	£	s.	d
Zinc sheets, spot	36	0	0
Do. V.M. ex. whf	36	0	0
Do. ppt., f.o.b., N.Y.			—
Dutch	36	0	0
Boiler plates	33	0	0
Battery plates	32	10	0

ANTIMONY.

	£	s.	d
English regulus	37	0	0
Special brands	42	0	0
Chinese	24	10	0
Crude	18	0	0

QUICKSILVER.

Quicksilver 11 2 6

FERRO-ALLOYS AND STEEL-MAKING METALS.

Ferro-silicon—
45/50% 16 0 0
75% 23 0 0
Ferro-vanadium—
35/40% .. 22/- lb. va.
Ferro-molybdenum—
70/80% .. 8/- lb. mo.
Ferro-titanium—
23/25%, carbonless 1/6 lb.
Ferro phosphorus, 20/23%, £29
Ferro-tungsten—
80/85%, carbon free 1/9 lb.
Tungsten metal powder—
98/99% .. .. 2/3 lb.
Ferro-chrome—
4/6% car. £37 0
6/8% car. £36
8/10% car. .. £35 10
Ferro-chrome—
Max. 2% car. .. £84
Max. 1% car. .. £100
Max. 0.75% car. .. £115
65/75%, carbonless 2/9 lb.
Nickel—99·8%, cubes or pellets .. £190
Cobalt metal—97%.. 15/- lb.
Aluminium—98/99% £150
Metallic Chromium—
98/99% .. .. 6/3 lb.
Ferro-manganese—
76/80%, loose .. £18
76/80%, packed .. £19
76/80%, export .. £16
Metallic manganese—
98/99%, carbonless 2/10 lb.
Per ton unless otherwise stated.

HIGH-SPEED TOOL STEEL.

	s.	d.
Finished bars, 14% tungsten	3	0
Finished bars, 18% tungsten	3	9
Scrap pieces		5d.
Turnings and swarf ..		3d.

Per lb. net, d/d buyers' works.

Extras—
Rounds and squares 3 in. to 8 in. inclusive 4d. lb.
Rounds and squares under ½ in. to ¼ in. 3d. lb
Flats under 1 in. by ⅜ in. to ½ in. by ¼ in., and all sizes over four times in width over thickness .. .. 3d. lb.
Bevels of approved sizes and sections .. 6d. lb.
If in coils .. .. 3d. lb.
Packing .. ..4s. cwt
Bars cut to length 10% extra
Scrap from high-speed tool steel—
Scrap pieces .. .. 5d.
Turnings and swarf .. 3d.

Per lb. net, d/d steel makers' works.

SCRAP.

South Wales—£ s. d.	£	s.	d.
Heavy Steel	3	0	0
Bundled steel & shearings	2	15	0
Mixed iron & steel .. 1 0 0	3	10	0
Heavy cast iron ..	3	15	0
Good machinery for foundries ..	5	10	0
Cleveland—			
Heavy steel ..	2	10	0
Steel turnings ..	2	7	6
Cast-iron borings	2	7	6
Heavy wrought iron piling	3	0	0
Bundling scrap ..	4	5	0
Cast-iron scrap ..	5	10	0
Lancashire—			
Cast iron scrap ..	6	0	0
Heavy wrought ..	3	0	0
Steel turnings ..	1	10	0
London—			
Copper (clean) ..	51	0	0
Brass (clean) ..	30	0	0
Lead (less usual draft)	18	10	0
Tea lead	16	10	0
Zinc	13	0	0
New aluminium cuttings ..	70	0	0
Braziery copper ..	41	0	0
Gun metal ..	45	0	0
Hollow pewter ..	135	0	0
Shaped black pewter	80	0	0

PIG-IRON.

	£	s.	d
N.-E. Coast—			
Foundry No. 1 ..	125/-		
Foundry No. 3 ..	120/-		
Forge No. 4 ..	117/6		
Mottled ..	117/6		
Hematite No. 1 ..	162/6		
Hematite M/Nos. ..	160/-		
Midlands—			
Staffs. common ..	145/-		
,, part-mine forge	160/-		
,, ,, foundry	170/-		
,, Cold blast ..	320/-		
,, basic	140/-		
Northants forge ..	140/-		
,, foundry No. 3	147/6		
,, basic	140/-		
Derbyshire forge ..	150/-		
,, foundry No. 3	160/-		
,, basic ..	150/-		
Scotland—			
Foundry No. 1 ..	170/-		
,, No. 3 ..	165/-		
Hematite M/Nos. ..	180/-		
Sheffield (d/d district)—			
Derby forge	155/-		
,, foundry No. 3	160/-		
,, basic	155/-		
Lincs. forge	160/-		
,, foundry No. 3	170/-		
,, basic	162/6		
E.C. hematite ..	173/-		
W.C. hematite ..	176/-		
All d/d in the district.			
Lancashire (d/d eq. Man.)—			
Derby forge	—		
,, foundry No. 3	170/-		
Northants foundry No. 3	—		
Cleveland foundry No. 3	—		
Staffs. foundry No. 3	—		
Lincs. forge	172/6		
,, foundry No. 3	177/6		
Summerlee foundry ..	193/-		
Glengarnock foundry	195/6		
Gartsherrie foundry	193/-		
Monkland foundry ..	193/-		

FINISHED IRON & STEEL.

Iron—	£	s.	d.
Bars (cro'n)	19	0	0
Angles ..	19	10	0
Tees to 3 united ins. ..	20	0	0
Nut and bolt ..	19	0	0
Hoops	23	0	0
Marked bars (Staffs.) ..	27	10	0
Gas strip ..	22	0	0
Bolts and nuts, ¾ in. × 4 in.	38	0	0
Steel—			
Ship plates ..	19	0	0
Boiler plates ..	25	0	0
Checquer plates	20	0	0
Angles	17	10	0
Tees	18	10	0
Channels ..	18	0	0
Joists	17	10	0
Rounds, ¾ in.–3-in.	14	0	0
Rounds, 3 in.–5½ in. ..	13	0	0
Flats, 5 in.–8 in.	14	10	0
Flats over 8 in.	13	0	0
Rails, heavy ..	15	0	0
Fishplates ..	20	0	0
Hoops	16	10	0
Black sheets, 24 g.	19	10	0
Galv. cor. sheets, 24 g.	22	0	0
Galv. fencing wire, 8 g. plain ..	23	10	0
Rivets, ¾ in. dia	27	0	0
Billets, soft ..	11	10	0
Billets, hard ..	12	10	0
Sheet and tin bars	11	10	0

PHOSPHOR BRONZE.

ROLLED.	Per lb. s.	d.
¼ in. to 1 in. wide ..	1	9½
1 in. to 1½ in. wide ..	1	8½
1½ in. to 2 in. wide ..	1	6½

STRIPS.	s.	d
2 in. to 6 in. to 26 S.W.G.	1	6½
6 in. to 12 in. to 26 S.W.G.	1	6½

SHEETS.	s.	d.
12 in. to 18 in. to 24 S.W.G.	1	6½
18 in. to 24 in. to 24 S.W.G.	1	7¼
24 in. to 30 in. to 20 S.W.G.	1	8½
30 in. to 36 in. to 16 S.W.G.	1	8¾
36 in. to 42 in. to 16 S.W.G.	1	9¾

EXTRAS.

FOR GAUGE: Any width up to 36 in. wide, ¼d. per lb. per thinner gauge.

DRAWN RODS.	s.	d.
¼ in. to ½ in. dia. in random lengths; ⅝ in. to 1½ in. dia. in random lengths	1	6
Over 1½ in. to 1¾ in. ..	1	6
Tubes—basis price ..	1	8½

Delivery 2 cwt. free to any town.
10% phosphor copper, £40 above price of B.S.
15% phosphor copper, £50 above price of B.S.
Phosphor tin (5%), £30 above price of English ingots.
CHARLES CLIFFORD & SON, LIMITED, BIRMINGHAM.

NICKEL SILVER, SHEET METAL, WIRE AND TUBES.

	Per lb.
Ingots for raising	1/1 to 1/7
Rolled—	
To 9 in. wide	1/8½ to 2/2½
To 12 in. wide	1/9 to 2/3
To 15 in. wide	1/10 to 2/4
To 18 in. wide	1/11 to 2/5
To 21 in. wide	2/- to 2/6
To 24 in. wide	2/1 to 2/7
Ingots for spoons and forks ..	1/1 to 1/7
Ingots rolled to spoon size ..	1/4 to 1/10
Wire round—	
3/0 to 10. G. ..	1/11 to 2/6

with extras according to gauge.

AMERICAN IRON & STEEL.

At Pittsburgh unless otherwise stated.	Dols.
No. 2X foundry, Phila.	25.81
No. 2 foundry Valley	23.50
No. 2 foundry, Birm.	22.00
Basic	23.96
Bessemer	25.96
Malleable	25.96
Grey forge	23.46
Ferro-manganese 80 % delievred	85.00
Bess. rails, h'y, at mill	45.00
O.-h. rails, h'y, at mill	47.00
Bess. billets	37.00
O.-h. billets	37.00
O.-h. sheet bars ..	39.00
Wire rods	48.00
	Cents.
Iron bars, Phila. ..	2.35
Steel bars	2.10
Tank plates	2.20
Beams, etc.	2.20
Skelp, grooved steel ..	2.20
Skelp, sheared steel ..	2.20
Steel hoops	2.75
Sheets, black, No. 28 ..	4.00
Sheets, galv., No. 28 ..	5.00
Sheets, blue an'l'd, 9&10	3.10
Wire nails	3.00
Plain wire	3.00
Barbed wire, galv. ..	4.10
Tinplate, 100-lb. box ..	$6.25

COKE.

Welsh foundry 67/6
,, furnace 55/-
Durham & North. foundry 70/-
,, furnace 42/6
Other Districts, foundry 77/9
,, furnace 45/-

SWEDISH IRON.

Bars, hammered basis sizes Basis price £31 to £32

Rolled Ordinary— Assortment ..	£ s. d.	
Nail Rods— Square, round and flats ..	22 10 0 to 23 10 0	
Keg Steel	..	£38 to £40
Faggot Steel	..	£30 to £32
Blooms— Single welded	..	£16 to £18
Billets— Single and double welded	..	£18 to £23
Pig-Iron— Grey, white or mottled	..	£12/10 to £14

Prices are without engagement. All quotations are f.o.b. Gothenburg, net cash against documents there.

TUBES.

	Up to and incl. 2 in.	Over 2 in.
Gas ..	−15%	−20%
Water ..	− 5%	−11¼%
Steam ..	+ 6¼%	− 1¼%

TINPLATES.

I.C. Cokes,	20×14, box	26/-
,,	28×20, ,,	53/-
,,	20×10, ,,	37/-
,,	18¾×14, ,,	30/-
I.X.	,,	68/-
I.X.X.	,,	88/-
F.C.B.Y.	21×13⅝ ,,	50/6
C.V.B.G.	16½×15, ,,	50/-
I.C.W.	20×14, ,,	21/6
,,	28×20, ,,	40/-
,,	20×10, ,,	29/-
,,	18¾×14, ,,	20/-
Terneplates,	28×20, ,,	53/-

DAILY FLUCTUATIONS.

Standard Copper (cash).

	£	s.	d.		
June 1	73	0	0	inc.	10/-
,, 2	73	2	6	,,	2/6
,, 3	72	12	6	dec.	10/-
,, 6	72	15	0	inc.	2/6
,, 7	72	15	0	No change	

Electrolytic Copper

June 1	76	0	0	No change	
,, 2	76	10	0	inc.	10/-
,, 3	76	0	0	dec.	10/-
,, 6	76	0	0	No change	
,, 7	76	0	0	,,	

Standard Tin (cash).

June 1	173	0	0	dec.	20/-
,, 2	172	10	0	,,	10/-
,, 3	170	5	0	,,	45/-
,, 6	168	5	0	,,	40/-
,, 7	165	15	0	dec.	50/-

Tin (English Ingots)

June 1	171	0	0	dec.	20/-
,, 2	170	10	0	dec.	10/-
,, 3	168	0	0	,,	50/-
,, 6	166	10	0	,,	40/-
,, 7	163	0	0	dec.	70/-

Zinc Sheets (spot).

June 1	36	0	0	No change
,, 2	36	0	0	No change
,, 3	36	0	0	No change
,, 6	36	0	0	No change
,, 7	36	0	0	No change

Spelter (ordinary).

June 1	27	10	0	inc.	5/-
,, 2	27	7	6	dec.	2/6
,, 3	27	0	0	,,	7/6
,, 6	26	10	0	,,	10/-
,, 7	26	10	0	No change	

Lead (English).

June 1	24	0	0	inc.	5/-
,, 2	23	15	0	dec.	5/-
,, 3	23	10	0	,,	5/-
,, 6	23	10	0	No change	
,, 7	23	15	0	inc.	5/-

SHROPSHIRE IRON Co., Ltd.

Works :— Hadley, Shropshire.

London: 10, Bush Lane, Cannon St., E.C.4.

Telegrams :— Sun, Wellington, Salop. Sunbrand (Cannon), London.

Telephone :— 11 Wellington, Salop. 5959 Central.

BARS, HOOPS, SECTIONS & WIRE
in IRON, STEEL, COPPER and BRONZE.

Galvanised Telegraph, Telephone, Cable and Trolley Wire
To all Specifications.

Contractors to H.M. Government (Admiralty, G.P.O., India Office, War Office, Colonies), English and Foreign Railways, &c.

BEST H. C. COPPER & BRONZE WIRE a speciality.

Medals :—Sydney (Bronze) 1879, New Zealand (Gold) 1882, Liverpool (Silver) 1886, Adelaide (Gold) 1887, Franco-British Grand Prix (Highest Award) 1908.

ROBERT HEATH & LOW MOOR, LIMITED,
Stoke-on-Trent.

S.S.H. IRON.
At works.
BARS, ANGLES, TEES and PLATES.

R.H. ♔ IRON.
Delivered F.O.B. Liverpool.
BARS, ANGLES, TEES and PLATES.

HOOPS delivered F.O.B. Liverpool.

IRON
R.D. ♔
RAVENSDALE (Best)

MILD STEEL (up to 2in. wide)
Marked
"HEATH'S SOFT STEEL."

Prices on Application.

WILLIAM JACKS & COMPANY,
5, EAST INDIA AVENUE, LONDON, E.C.3.

Telegrams : ALKALIZE, BIRMINGHAM.
Telephone : CENTRAL 1175 & 1176
Birmingham Office:
18, BENNETT'S HILL.

Telegrams : ALKALIZE, LONDON.
Telephone : 7860 AVENUE (3 lines.
Head Office:
5, EAST INDIA AVENUE, London, E.C.

REGISTERED TRADE MARK

PIG IRON.

Scotch, Middlesbro,' Hematite, Basic, Specials, &c., &c.

TIN — SPELTER — CHROME
COPPER — ANTIMONY—MANGANESE.

WILLIAM COLVIN & COMPANY,

ROYAL EXCHANGE, MIDDLESBROUGH.

93, HOPE STREET, GLASGOW.

SITUATIONS VACANT AND WANTED.

IRON FOUNDRY FOREMAN COREMAKER desires change; make your own core oil, 80 parts sea-sand 1 part oil.—Box 770, Offices of the FOUNDRY TRADE JOURNAL, Bessemer House, 5, Duke Street, Adelphi, London, W.C.2.

LEADING MOULDER required for Aluminium Foundry in South London; must have exceptional experience with large work other than motor trade.—Write, "CHARGEHAND," c/o Box No. 768, Offices of the FOUNDRY TRADE JOURNAL, Bessemer House, 5, Duke Street, Adelphi, London, W.C.2.

WANTED, for Johannesburg, to operate 6/7 ton Héroult Electric Furnace, a Foreman to take charge of furnace, a Chemist, and a Ladle Hand.—Apply, in writing, to MESSRS. A. L. SECRETAN & COMPANY, LIMITED, 1, Broad Street Place, Finsbury Circus, London, E.C.2, stating experience and pay required.

AGENCY.

REPRESENTATION.—Wanted, in London and District, with wide connection, to represent Non-Ferrous Foundry for the supply of Engineer and Motor Trade Castings (on Admiralty and War Office Lists), output fifty tons weekly. Only established and influential firms considered.—Reply Box 762, Offices of the FOUNDRY TRADE JOURNAL, Bessemer House, 5, Duke Street, Adelphi, London, W.C.2.

PARTNERSHIP.

SMALL FOUNDRY, in Midland District, wants to link up with another Foundry or take another partner that can influence work. — For particulars, apply Box 764, Offices of the FOUNDRY TRADE JOURNAL, Bessemer House, 5, Duke Street, Adelphi, London, W.C.2.

MACHINERY.

TURN TO THE B.W.S. ANNOUNCEMENT, PAGE 10.

WANTED good Secondhand 15 to 30 cwt. geared Crane Ladle.—Box 766, Offices of the FOUNDRY TRADE JOURNAL, Bessemer House, 5, Duke Street, Adelphi, W.C.2.

DRILLING MACHINE, by Scriven & Holdsworth; excellent condition, double geared, 30-in. faceplate, vertical and cross traverse, weight about 2 tons; £60 for quick sale.—CORNELIUS, "Reliance" Gas Engine Works, Beechfield Road, Doncaster.

JIB CRANES for Sale, five and ten tons; seen working. Replacing with Electric. Cheap to immediate purchasers.—Apply TOWER FOUNDRY, Aston Road North, Birmingham.

HALL'S Invincible Sand Mixer, capacity 1 ton per hour, 18 in. dia., equal to new, suitable for mixing and preparing all kinds of foundry sands at the lowest cost per ton.—Apply, C .E. V. HALL, 26, Paradise Square, Sheffield.

FOR SALE.—New and Second-hand Foundry Plant. 50 Pairs Steel Moulding Boxes, 16 in. x 14 in. x 6 in.; centre of holes 19 in. Two Adaptable Moulding Machines. Two 1-ton Morris Elevating Trucks. One Tilghman's Sand Blast Plant, with Compressor.—Address, Box 744, Offices of the FOUNDRY TRADE JOURNAL, Bessemer House, 5, Duke Street, Adelphi, London, W.C.2.

"ABRAHAM" PORTABLE MOULDING MACHINES,
Fitted with Turnover Attachment.
save 50 per cent. on labour. A boy can make 120 good moulds per day. The unskilled operator cannot help getting a perfect draw. Price £25. Send for list.

DINGLEY PARSONS & CO.,
Guildhall Buildings, Navigation Street,
Birmingham.

You save money by buying from us!
Lancashire Boiler, 30 ft. x 8 ft., for 120 lbs. w.p.
Loco. Type Boiler, by Robey, 105 lbs. w.p.
5-ton Overhead Foundry Crane, 30 ft. span.,
35-h.p. Modern Crossley Gas Engine, "U" Type.
20, 30, 40 and 50-h.p. Electric Motors, 460 Vo. D.C.
Blowers, Fans, Engines, etc. Send your enquiries, HARRY H. GARDAM & COMPANY, LIMITED, Staines. 'Phone 98.

MACHINERY—*Cont.*

FOR SALE.

Five DAVEY PAXMAN ECONOMIC BOILERS, each 14 ft. x 8 ft., for 160 lbs. working pressure, and two ditto 180 lbs. working pressure.

Four New THOMPSON DISH-ENDED LANCASHIRE BOILERS, 30 ft. x 8 ft. 6 in., for 150 lbs.

Five LANCASHIRE BOILERS, 30 ft. x 7 ft. 6 in., now insured at 160 lbs. pressure.

Three MARINE WATER TUBE BOILERS, by Yarrow, each 4,000 sq. ft. htg. surface, reinsure 200 lbs. pressure.

Two MARINE BOILERS, 10 ft. 4 in. long x 12 ft 2 in. diam., reinsure 150 lbs. pressure.

MARINE TWO FURNACE BOILER, 9 ft. 6 in. diam. x 10 ft. long, reinsure 100 lbs. pressure.

One LOCO. TYPE BOILER, barrel 12 ft. long x 4 ft. 8 in. diam., reinsure 150 lbs pressure.

Twenty-four MARINE TYPE SELF-CONTAINED WATER TUBE BOILERS, by Messrs. Babcock & Wilcox, Limited, varying in heating surface from approximately 1,610 to 2,813 sq. ft. per boiler, constructed for a working steam pressure of 270 lbs. per sq. in.

One HORNSBY WASTE HEAT WATER TUBE BOILER, about 40-h.p., reinsure 160 lbs. pressure.

CAST-IRON TANK, in plates about 40 ft x 35 ft. x 8 ft. deep, capacity about 70,000 galls.

Two nearly new PRESSED STEEL SECTIONAL TANKS, each 16 ft. x 12 ft. x 8 ft. deep, capacity 9,600 galls. each.

Several Unused SECTIONAL STEEL CISTERNS, 8 ft. x 8 ft. x 4 ft. deep capacity, about 1,600 galls. each.

Three MILD STEEL RIVETED OPEN TOP CISTERNS, each 11 ft. 3 in. long x 7 ft. 7 in. wide x 9 ft. deep x ¼ in. thick, capacity about 4,760 galls. each.

Several DISH-ENDED CYLINDERS, each 6 ft. x 2 ft., tested hydraulically to 150 lbs. pressure.

Large number of GALVANISED STEEL WIRE ROPES, each 300 ft. long x 1¼ in circumference; thimble at one end.

One FLAT-ENDED RECEIVER, 10 ft. 6 in. long x 3 ft. 6 in. diam. x ½ in. thick.

SECTIONAL TELESCOPIC LADDER, six 10-ft. wood sections, on four wheel carriage.

One WROUGHT IRON RIVETED CHIMNEY, 50 ft. long over all x 4 ft diam., tapering in the last 15 ft. to 8 ft. diam. at the base. Plates about 5/16 in. to 7/16 in. thick. Excellent condition.

One Ditto, 40 ft. long x 4 ft. diam. throughout, plates about ½ in. thick, fitted with Angle at either end and internal ladder.

134 ROOF PRINCIPALS, each 21 ft. span x 5 ft. 3 in. rise in centre.

Six Ditto, 26 ft. 6 in. span x 5 ft. 3 in. rise in centre.

LANCASHIRE BOILER, 24 ft. x 7 ft. 6 in. diam., reinsurable 80 lbs. per sq. in. working pressure.

CATALOGUE of STOCK MACHINERY, 5-6,000 Lots.
Free on Application. Inspection Invited.

THOS. W. WARD, Albion Works, SHEFFIELD.
Telegrams: "Forward, Sheffield."
Telephone: 4321 (8 lines).

MISCELLANEOUS.

SPECIAL OFFER. Subject to being Unsold. Best New Perfect Sheffield Files. 14-in. Hand Bastard, parallel, one safe edge; makers, John Kenyon & Company, Sheffield. 12-in. Hand Second Cut, parallel, one safe edge; makers, Camm, Bagshaw & Company, Sheffield. All at 18s. per dozen. Carriage paid on 12 dozen lots.—SMITH BROS., Aylestone Park, Leicester.

NUTS and Bolts, Bright Engineers' Machined, suitable for garages and works, etc., one gross assorted from ¾ by 3-16 to 4 by 5-16, in good strong wooden boxes; 15s each carriage forward, 16s. each carriage paid, worth double. Send cash with order. Send for Price List of Tools.—HORWOOD & CO., LTD., Dudley.

For continuation of small advertisements see page 524.